Report No. UT-05.17

ANNUAL UTRAC WORKSHOP ON TRANSPORTATION RESEARCH NEEDS

2005 PROCEEDINGS

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November 2005

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UDOT RESEARCH & DEVELOPMENT REPORT ABSTRACT

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16. Abstract

An annual workshop (known as the UTRAC Workshop) was held on March 3, 2005 to discuss and prioritize the research needs of the Utah Department of Transportation (UDOT). Participants included UDOT managers and employees, Federal Highway Administration (FHWA) staff, individuals from other government agencies, researchers from the local Universities, consultants, contractors, and other interested parties. Problem Statements, describing research needs of the Department, were submitted prior to the workshop and then evaluated, modified, and prioritized by working groups at the workshop. This document describes the UDOT research prioritization process, the UTRAC workshop and the resulting list of prioritized Problem Statements.

The UTRAC Workshop included a plenary session, with a keynote address by UDOT Deputy Executive Director Carlos Braceras, P.E., an update on the status of various research projects, and the presentation of the Trailblazer Award to Mr. Stan Burns, P.E., the immediate past Director of Research at UDOT, for his implementation of outreach and accountability in the Division. Much of the workshop was devoted to the evaluation of Problem Statements by groups of people organized by topic area. The eight topic area groups were: construction, maintenance, materials and pavements, hydraulics and environmental, planning and asset management, traffic management and safety, geotechnical, and structural. Each group used a voting process to determine the most important research needs in their discipline, in ranked order. A total of 80 Problem Statements were considered at the workshop, and 40 statements were prioritized. Of those 40 statements, the top 21 have been listed for potential funding by the Research Division, plus four projects not considered at UTRAC but deemed strategically important by UDOT's senior leaders.

The UTRAC workshop was held at the Officers Club of historic Fort Douglas, on the University of Utah campus, in Salt Lake City, Utah. A total of 153 people participated in the workshop.

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EXECUTIVE SUMMARY

The Research Division of the Utah Department of Transportation (UDOT) held its annual UTRAC Workshop on March 3, 2005, at the Officer's Club of historic Fort Douglas, on the University of Utah campus in Salt Lake City, Utah. The purpose of the workshop was to discuss and prioritize the research needs of the Department, in preparation for the 2006 Fiscal Year. Attending the workshop were 153 people from various divisions within UDOT, the Federal Highway Administration (FHWA), other government agencies, the three research Universities in Utah, consultants, contractors, and other interested parties.

Initiated in 1993, the Utah Transportation Research Advisory Council (UTRAC) workshop has provided guidance to the UDOT Research Division in the allocation of research funding and efforts. This year, significant changes to the format of the workshop and the methods used to develop and prioritize research needs were instituted. These changes included pre-submitted Research Problem Statements, expansion in the number of discipline groups at the workshop, and secret voting during the prioritization process.

Research needs are identified by Problem Statements, which were submitted in advance of the workshop. These Problem Statements were then evaluated, modified, and prioritized by eight discipline area working groups at the workshop. Each group used a voting process to determine the most important research needs in their discipline, in ranked order. The discipline area groups were: construction, maintenance, materials and pavements, hydraulics and environmental, planning and asset management, traffic management and safety, geotechnical, and structural.

This year, a total of 80 Problem Statements were considered at the workshop, and 40 statements were prioritized by the working groups. Of those 40 statements, 21 have been listed for potential funding by the Research Division, plus four projects deemed strategically important by UDOT's senior leaders. These leaders have approved the recommended project list, and work is underway on these research projects.

Participants at the UTRAC Workshop were welcomed by the UDOT Engineer for Research, Rukhsana Lindsey, and heard a keynote address from UDOT Deputy Executive Director Carlos Braceras, P.E. Mr. Braceras described actions of the Utah Legislature relative to funding transportation in Utah, and the innovations UDOT has implemented to improve the way the Department serves the public in Utah. Presentations were also given by several UDOT engineers on innovative topics, including public input on the Mountain View Corridor project, performance of innovative geotechnical features of the I-15 Reconstruction Project, and Vehicle detection and classification using fuzzy logic.

During the plenary session, the UTRAC Trailblazer Award was presented to Mr. Stan Burns, P.E., the Director of UDOT Engineering Services, for his efforts to advance transportation research within the Department. Mr. Burns recently served as Director of Research, where he encouraged improvements in the UTRAC process and instituted new outreach and accountability in the Division.

This report summarizes the agenda and proceedings of the 2005 UTRAC Workshop, and presents the final list of Problem Statements recommended for funding and the priority lists developed by each of the discipline area working groups. A list of all the Problem Statements

considered during the workshop, and the complete text of each Problem Statement, is also included.

The 25 Problem Statements ranked for potential funding are shown below, including the funding priority, the Problem Statement number and title, the UDOT Champion, the discipline area relevant to the project, and the approximate budget anticipated.

Funding Priority	Prob No.	Problem Title	Champion/Discipline	Approx Budget
1	05.01-1	Mitigate Queue Lengths in Work Zone Traffic Control	Pete Negus/Construction	$50,000
2	05.02-02	Cost-Effectiveness & Indicators-Pavement Rejuvenation	Scott Nussbaum/Maintenance	$80,000
3	05.03-4	Full-Depth Recycling and Stabilization of Pavement Base Layers	Nathan Lee/Materials	$100,000
4	05.04-6	Design Methods for Unique Culvert Installations	Denis Stuhff/Hydraulics	$35,000
5	05.05-7	Extract Vehicle Classification from TOC Video	Chris Glazier, Richard Manser/Planning	$34,000
6	05.06-6	Advanced Warning Signal Site Selection Evaluation Matrix	Mack Christensen/Traffic	$35,000
7	05.07-3	Dynamic Passive Pressure on Abutments & Pile Caps	Bischoff , Boyle, Sjoblom/Geotechnical	$75,000
8	05.08-1	Improvement of Deck Concrete Mix Design and Curing Practices	Todd Jensen/Structural	$70,000
9	05.01-3	Worker Visibility	Darrell Giannonatti/Construction	$25,000
10	05.02-06	Skid Index Trigger Values	Bill Lawrence/Maintenance	$10,000
11	05.03-1	Asphalt Binder Uniformity	Kevin VanFrank/Materials	$90,000
12	05.04-2	Bridge Scour Countermeasure Phase II	Michael Fazio, Denis Stuhff, Tim Ularich/Hydraulics	$42,000
13	05.05-3	Access Management Performance Index	Tim Boschert/Planning	$35,000
14	05.06-7	Access Management/Traffic Impact Analysis Training	Tim Boschert/Traffic	$30,000
15	05.07-2	Programming of Strong Ground Motion Instrumentation of New Bridges	Jim Higbee/Geotechnical	$30,000

16	AM.05.001	Evaluation of Effects of Stay in Place Forms on Bridges	Todd Jensen/Structural	$50,000
17	05.04-1	Design & Development of a Context Sensitive Visual Resource Assessment and Management (VRAM) System for UDOT	Terry Johnson, Lars Anderson/Environmental	$88,000
18	05.02-07	Targeted and Adaptive Simulator Training for Winter Maintenance	Richard Clarke, Shana Lindsey/Maintenance	$10,000
19	05.05-11	Determination of Crash Costs for Use in Benefit/Cost Analysis (Value of Life)	Jim McMinimee/Administration	$25,000
20	AM.05.002	Evaluation of Rapid Mapper Technology	Lisa Wilson/Roadway Design	$42,000
21	AM.05.003	Older Driver Study: Evaluation of Safety Effects of Pavement Markings and Signage	Administration	$80,000
22	AM.05.004	Pavement Marking Study (Test Sections)	Shana Lindsey/Maintenance	$5,000
23	05.05-10	Good Roads Cost Less	Kim Schvaneveldt/Planning	$20,000
24	05.03-3	SMA Paving Mechanistic Properties	Rodney Terry/Materials	$100,000
25	05.07-6	Geophysical methods to prioritize mitigation options for SR-9 in the Coal Hill landslide area	Leslie Heppler/Geotechnical	$19,500

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INTRODUCTION

The UDOT Research Division is charged with promoting, executing and implementing research activities within the Utah Department of Transportation, to further the mission of the Department and increase the Department's use of new products and techniques. A key component in the execution of this charge is the UTRAC Workshop, a collaborative, annual event held to discuss and prioritize the research needs of the Department.

The 2005 UTRAC Workshop was held on March 3, 2005, at the Officer's Club of historic Fort Douglas, on the University of Utah campus in Salt Lake City, Utah. The results of this Workshop will contribute significantly to the development of the UDOT Research Work Program for the 2006 Fiscal Year.

The UTRAC Workshop also serves to satisfy federal regulations relating to the use of federal research funds. Research efforts at UDOT are supported largely by federal funds. Federal regulation mandates that the states certify the proper use of these funds, and stipulates that they develop, establish, implement and document a management process that identifies and implements research, development and technology transfer activities to address priority transportation issues. The UTRAC Workshop is a key element in the "identification" portion of this process, and aids the Division in the allocation of research funding and efforts.

Initiated in 1993, the UTRAC Workshop is named for the Utah Transportation Research Advisory Council, a group of UDOT leaders who previously oversaw the prioritization process. In the application of this process, which is described in detail in a subsequent section, the Research Division invites UDOT staff and other interested parties to gather in a one-day workshop to evaluate and prioritize UDOT's research needs. Although the workshop is typically held each year, the 2004 workshop was not held due to funding constraints.

In late 2004, the UDOT Research Division began an initiative to evaluate and improve the UTRAC process. Based on an analysis of feedback from three prior UTRAC workshops and some focused discussion with a group of regular participants, several key changes were made to the process. These changes include: advance submission of Problem Statements, elimination of the group brainstorming activity at the workshop, expansion of the workshop breakout groups from five to eight, weighted secret ballots in the breakout groups, and elimination of the external "Advisory Council" prioritization of Problem Statements. With these changes, the 2005 UTRAC Workshop began a new era in the history of the workshop.

In August 2005, AASHTO recognized the innovative and benefits inherent in the revised UTRAC process for prioritizing UDOT's research needs, and awarded the 2005 AASHTO President's Transportation Award for Research to the UTRAC Team.

Attending the 2005 workshop were 153 people from various divisions within UDOT, the Federal Highway Administration (FHWA), other government agencies, the three research Universities in Utah, consultants, contractors, and other people with interest in transportation research.

Research needs are identified by Problem Statements, which were submitted in advance of the workshop. These Problem Statements were then evaluated, modified, and prioritized by eight discipline area working groups at the workshop. The discipline area groups were: construction, maintenance, materials and pavements, environmental and hydraulics, planning and asset management, traffic management and safety, geotechnical, and structural. Each group used a voting process to determine the most important research needs in their discipline, in ranked order.

This year, a total of 80 Problem Statements were considered at the workshop, and 40 statements were prioritized. Of those 40 statements, 21 were selected and approved by UDOT's senior leaders for funding. Four additional projects, not considered during the UTRAC Workshop but deemed strategically important by the senior leaders, have been added to the list of projects to be funded by the Research Division. Available research funding is now being applied to the prioritized projects, in order of priority.

Lists of the Problem Statements considered at the Workshop, a list of those selected for potential funding, and the complete text of each Statement, are included in this Proceedings document.

This Proceedings also includes the agenda of the Workshop, the text of the keynote address by UDOT Deputy Executive Director Carlos Braceras, the presentation of the UTRAC Trailblazer Award to Mr. Stan Burns, the immediate past Director of Research for UDOT, and other pertinent information from the Workshop.

RESEARCH PRIORITIZATION PROCESS

Process Overview

The process of prioritizing research needs for the Utah Department of Transportation (UDOT) is based around a collaborative, annual workshop, organized by the UDOT Research Division. This workshop has come to be known as "UTRAC", the acronym for the Utah Transportation Research Advisory Council, a group of UDOT leaders who previously oversaw the prioritization process. In the current prioritization process, UDOT staff, FHWA staff, key consultants, research partners, contractors, and people from associated agencies gather to evaluate and prioritize UDOT's research needs. These needs are defined by Problem Statements that were submitted by many parties prior to the workshop. Available funding is applied to the highest priority Problem Statements, as determined during the workshop through a voting process.

The annual UTRAC Workshop was initiated in 1993, and has been a very successful process. The process has been modified several times, and underwent some significant revisions this year. The nature of these revisions will be discussed in a subsequent section.

The key steps employed in the 2005 research prioritization process at UDOT are shown below. Although the UTRAC Workshop played a central role in the process (step 6), a number of steps were needed before and after the workshop to make the process complete. The steps were:

1. Identified key leaders in the Department to lead the Problem Statement generation process in each of eight discipline areas. Those areas were:

    a. Construction
    b. Maintenance
    c. Materials & Pavements
    d. Environmental & Hydraulics
    e. Planning & Asset Management
    f. Traffic Management & Safety
    g. Geotechnical
    h. Structural

2. Assigned a person from the Research Division staff to work with each discipline group.

3. Provided background information to the group leaders on the prioritization process and their role within it.

4. Solicited Problem Statements from each of the discipline groups (and other stakeholders), making the leader for that group responsible to lead the Problem Statement development process. Many of the groups held brainstorming sessions to identify important topics for Problem Statements. The Problem Statement submission deadline was set about one month ahead of the workshop. Problem Statements were accepted from any entity, and did not need to come through the discipline group or its leader. Tools provided to each group leader included:

a. List of Problem Statements from the past year.
b. Problem Statement form (revised from previous years).
c. Suggestions about coordinating with contractors, consultants and key researchers during this early stage in the process to ascertain their needs, interests and resources.

5. Research Division staff contact for each discipline group reviewed the submitted Problem Statements. Their review included a literature search to determine if similar work had been performed in Utah or elsewhere, or if significant knowledge on the topic could be provided to the discussion. Project scopes were evaluated to insure that well-defined work tasks and clear deliverables were envisioned. Implementation plans were also required in the scope statements. As needed, revised Problem Statements were proposed to the group leaders.

6. Convened a one-day workshop to review the Problem Statements and prioritize them. The workshop included 153 people from UDOT, FHWA, key consulting and construction firms, the three research universities in Utah, other state agencies, and the public. Elements of the workshop included:

   a. Keynote address from Mr. Carlos Braceras, P.E., the UDOT Deputy Executive Director.
   b. Presentation of three innovative projects currently underway at UDOT.
   c. Divided into eight working groups to evaluate the Problem Statements, discuss scopes and deliverables, and establish priorities. Background information was presented by the authors of the Statements, and by the Research Division contact. A total of 80 Problem Statements were evaluated by the groups. The number of submitted Problem Statements per group ranged from three to eighteen.
   d. Prioritized the statements through a two-step, secret ballot voting process using weighted ballots that minimized the ability of any one subgroup to dominate the process (UDOT participants dominated the voting scheme, irrespective of the number of people present).
   e. During breaks throughout the day, groups were able to interact to share ideas, gather supporting information, and provide input on cross-discipline problems.

   f. Each discipline group concluded the workshop by submitting a list of their top three to six projects, in order of priority.

7. Research Program Manager assembled the prioritized Problem Statements from each discipline group into a master list of research priorities. This list included 40 Problem Statements.

8. Sorted the assembled Problem Statement list by order of priority, so that the number one priority of each discipline group was shown first, followed by the number two priorities, and so on.

9. Applied the available research funding to the priority-order Problem Statement list, starting

at the top of the list and working down, yielding a list of about 21 projects which could be funded in fiscal year 2006.

10. Presented the priority list and funding scenario to the Research Division Director for input and approval. Added four projects not considered at UTRAC, based on strategic Department needs as determined by senior leaders in the Department.

11. Assigned Research Division staff as Project Managers for each of the projects, and discussed possible Principal Investigators for each.

12. Submitted the final funding list for approval by the Department and FHWA, as part of the annual Research Program funding document.

13. Initiated the research projects.

Modifications to the Process

As indicated earlier, UDOT has used a collaborative, annual workshop format since 1993 to identify the research priorities for the Department. This process had come to be called "UTRAC", named for the Utah Transportation Research Advisory Council, a group who oversaw the prioritization process. In this process, the key stakeholders in the transportation research arena gathered to identify and prioritize research needs. For many years, the workshop was a 2-day event hosted by the three research universities in Utah as a rotating schedule. Much of the workshop time was occupied by a process of idea brainstorming, open ballot voting, and creation of Problem Statements to reflect the results of the brainstorming.

In late 2004, the UDOT Research Division began an initiative to improve and expand the process of defining and prioritizing the annual research agenda for the Department. The goals of this initiative were to more fully meet the needs of our UDOT customers, more completely define the appropriate questions and problems on which to focus our research resources, and to improve our record of implementation of research results. In-house evaluations had indicated that increasing the involvement of key stakeholders in the research process would yield more success and a higher level of implementation. In addition, budgeting constraints had limited the workshop to a 1-day format and mandated that it be held in the Salt Lake Valley, close to the majority of the participants. A thorough evaluation of feedback from three years of UTRAC workshops, and some focused discussion among a select group of regular participants, identified some key changes in the process, all of which were implemented in 2005.

The key changes made to the annual workshop process were as follows:

1. Required advance submission of problem statements. In the past, problem statements were developed and refined during a brainstorming process at the workshop. While the synergy of the brainstorming session was a positive feature, the time constraints often resulted in Problem Statements which were not fully developed and lacked broad support.

2. Encouraged pre-workshop meetings within UDOT Divisions and between the Divisions and key researchers. These meetings often involved brainstorming, retaining the benefits of this activity while moving it out of the workshop schedule.

3. Problem Statements were reviewed to determine if significant information already existed. Since problem statements were developed at the workshop prior to 2005 review of the existing body of knowledge on that topic couldn't take place until after the prioritization activities of the workshop.

4. Convened a workshop to focus on the refined Problem Statements, and divided into eight discipline groups to discuss and refine the statements. In the recent past, five discipline groups were used. This expansion allowed for representation and involvement from more from more disciplines within UDOT.

5. Prioritized the Problem Statements within each discipline group using a series of secret, weighted ballots. In the past, open voting using colored dots was employed. Secret ballots eliminated some of the influence and bias inherent in the open voting process. Weighted ballots insured that UDOT stakeholders, those responsible to implement results, had significant influence in the selection process.

6. Honored the priority list from each group by funding the top project from each group before moving on to lower priority projects.

7. Eliminated the use of an external "Advisory Council" (the source of the original UTRAC acronym) in the prioritization process. This Council, made up of mid-level UDOT managers, would typically take the list of prioritized projects after the workshop, and create a funding list without regard to the order that each group placed on their projects. With the commitment to honor each group's priority, described in Item 6, above, and the reliance on UDOT Senior Leaders for prioritization review, this external Council was no longer needed.

The benefits achieved through this significantly modified process were as follows:

1. Problem Statements were more completely conceived and developed.

2. Problem Statements had more buy-in from key stakeholders, which will result in more successful research projects and more complete implementation of the results.

3. Participants felt that their input played a more significant role in the process, because their priorities were honored in the final funding list.

4. Conflicting priorities exhibited in past years were eliminated in this process, because of the secret ballot voting system.

5. A higher number of people participated in the workshop (153) than ever before (130).

6. Research efforts on prioritized Problem Statements began much sooner after the workshop, and results will be available for implementation in a more timely manner.

7. Research resources (manpower and budgets) were more efficiently and uniformly applied to the various discipline areas in the Department, because a project from each discipline group was funded before lower priority projects were funded.

8. A solution to one Problem Statement was identified and provided before the workshop was even held, saving thousands of dollars on unnecessary research efforts.

9. Other states will benefit from the results and implementation of more appropriate and efficiently executed projects done in Utah.

Feedback from the UTRAC Workshop confirmed that this revised process was a success, with better statements being presented, more informed decisions being made, and yielding a list of projects which more closely aligns with broad Department needs and the Department mission. Seventy-five percent of respondents "strongly agreed" that advance submission of Problem Statements was effective, with the other 25 percent indicating that they "agreed". Ninety-three percent of respondents indicated that they started the workshop with a good set of Problem Statements. Attendance at the workshop exceeded previous maximum attendance by 17 percent. The opportunity for this large group of transportation professionals to communicate and evaluate challenges of our industry in a proactive setting was noted as a positive attribute of this process. As one group leader remarked, "This year's UTRAC was a big improvement over the past . . . Research did an outstanding job."

In August 2005, the UTRAC Workshop Team was awarded the AASHTO President's Transportation Award for Research. This award recognizes the improvements made in the UTRAC process, and the benefits derived from these improvements.

2005 UTRAC Workshop

Director of Research: Rukhsana Lindsey

Chair of UTRAC Event/Process: Blaine D. Leonard

UTRAC Steering Committee: Doug Anderson, Lynn Bernhard, Tim Biel, Rukhsana Lindsey, Michelle Page, Tim Rose, Chris Siavrakas

Workshop Group Leaders: Tim Biel, Jon Bischoff, Richard Clarke, Darrell Giannonatti, Brent Jensen, Todd Jensen, Richard Manser, Brent Schvaneveldt

Research Division Staff: Doug Anderson, Ken Berg, Daniel Hsiao, Blaine Leonard, Michelle Page, Richard Sharp, Robert Stewart, Abdul Wakil

Workshop Logistics Team: Elaine Chatfield, Ken Berg, Rae Ann Jensen, Raeleen Maxfield

FHWA Support: Paul Mooney

2005 UTRAC Workshop Basic Agenda

The UTRAC Workshop was held on March 3, 2005, at the Officer's Club of historic Fort Douglas, on the University of Utah campus in Salt Lake City, Utah. The workshop was attended by 153 people from various divisions within UDOT, the Federal Highway Administration (FHWA), other government agencies, the three research Universities in Utah, consultants, contractors, and others. The workshop consisted of three main sessions and three breakout sessions. During the breakout sessions, discipline groups discussed, modified, and prioritized Problem Statements. The complete Workshop Agenda is included in the Appendix of this report. The basic outline of the sessions was as follows:

Introductory Plenary Session:
- Welcome – Rukhsana Lindsey, Director of Research
- Keynote Address – Carlos Braceras, UDOT Deputy Executive Director
- Technical Presentations: Teri Newell, Chris Glazier, Clifton Farnsworth, Project Manager
- Workshop Instructions - Blaine Leonard, Research Project Manager

First Breakout Session:
- Problem presentations, discussion, and first prioritization voting

Lunch Session:
- Presentation of Trailblazer Award – Rukhsana Lindsey, Dir. of Research
- Technical Presentations: Chris Glazier, GIS Specialist, Clifton Farnsworth, Research Project Manager

Second Breakout Session:
- Problem Statement Refining: Objectives, Tasks, Benefits, Champions, Implementation

Third Breakout Session:
- Problem Statement refinement & discussion:
- Deliverables, Tasks & Budget
- Final Prioritization Voting
- Summary Plenary Session:
  - Submittal of Prioritized Project Lists
  - Awarded of Door Prizes – Barry Sharp, New Products Coordinator

Each workshop participant was given a packet of information, which included an agenda, a list of breakout groups and room assignments, a list of all the Problem Statements being considered by each group, and a copy of each of the Problem Statements being considered by the group the participant is assigned to. The Group Leader and Research Advisor assigned to each group were each given a binder containing a copy of every Problem Statement being considered by all the groups, ballots for voting in their group, and a spreadsheet (on disk) to be used to tally the ballots. They were also given an instruction sheet on how to manage the group and the voting process.

WORKSHOP ACTIVITIES

Opening Remarks

Rukhsana Lindsey, Engineer for Research and Development

I would like to welcome all of you today, and thank you for taking the day to be with us. As I look around the room, I see great minds. I was hoping for the room to be full of great minds and intellects to help us decide what research we should be doing in the future. Today will be one of the most important and productive days that you have ever spent. Research has been behind the scenes in the past, and the last Director of Research, Stan Burns, brought Research into the forefront, more useful and more of a tool for the Department. We will commit to continuing this trend. We want you to look to the Research Division for solutions. Before trying out new ideas, we want you to run it past Research so we can do some TRIS searches for you, so you don't waste your time doing things that have already been done by someone else. We also want you to look to us to help identify the state of the art, and to find out what other states are doing. We can do some research on that and give you some information very quickly, and then you can make better decisions in your area.

We also want you to look to us for evaluating new products. We have a section in Research that tests out new products and puts them on a new products acceptance list. That allows you to choose products knowing what is wrong and right with them, using the right product for your use. We would like to be an addition to your staff, a tool to you. Whenever there is an issue in your area, we would like you to look to us for help. We have a lot of resources. If you look around here today, we have consultants and Universities with us. We can use these resources to help you, today and in the future, to find answers.

It is my pleasure to introduce Carlos Braceras, the UDOT Deputy Director and Chief Engineer, who is our keynote speaker today. Thanks for being with us today, Carlos.

Keynote Address

Carlos Braceras, UDOT Deputy Director

It is a great pleasure to be here today. What a great day it is today. While driving in, the sun was shining, birds were singing, the legislature was not in session. I had no appreciation for what it meant to a State Agency while the Legislature is in session until I accepted this position back in May 2001. Time goes fast.

I would like to offer a little bit of update about what the Legislative session meant to us.

Everyone is aware of the economic troubles of the state. We have been in an economic downturn. Over the last three years prior to this session, the primary mission that I had at the legislature was to fight to keep our operations budget, the piece that funds all of our salaries, our current expenses, the things that run the day-to-day operations of the Department. We were essentially able to keep those where they are, keep them at a flat level. But then the other piece was to try to maintain the general fund portion, the piece that was coming into the Centennial Highway Program (CHP). The CHP started in 1997, and consisted of 41 projects, plus the I-15 reconstruction, and was funded through the gas tax that was passed in 1997, some vehicle registration fees, the difference in moneys that we receive from the Federal Highway Administration (between ISTEA and TEA-21, about 450 million dollars) and general fund money. The general fund contribution was supposed to grow every year, starting in 1997 and finishing in 2007. By the end of 2007, we were supposed to advertise our last project and we would have also paid off the program by that time. Hard times hit the state, and they started pulling back the general fund moneys. We ended up trying to establish a basement level, of about 59.5 million dollars that needed to be in there so we could pay the debt service on the bonds. Essentially the bonds got extended out through 2020. This year, there was extra money on the table.

Two years ago the Legislature started to get concerned about congestion. They invested a lot of money in the Centennial Fund, and they started saying 'we still have a ton more needs'. They started with the Transportation Planning Task Force. We spent two years working through the interim sessions of the Legislature, identifying the needs and trying to find alternate ways of funding those needs. Some significant bills came out this year and were pushed forward to help transportation in the State of Utah. What happened during this session is very unique for Utah. The level of support that Transportation received is unprecedented around the country, relative to general fund money. Typically, what other DOT's are seeing is an erosion of their transportation funds, the money generated by gasoline taxes. That money is being pulled into the general funds to help fund the general needs of the state. We were different. Money was being moved from the general fund into transportation. The most significant bill in this Legislative session was House Bill 18. This bill called for $90 million from the general fund this year to be put into the Transportation Investment Fund, and next year another $90 million, for a total of $180 million going into transportation. This would be an on-going investment, every year, into transportation. Then, there would be some increased fees, mostly in the truck area, that would generate about another $25 million. Every subsequent year, there would be a 0.56% increase on that 180 million dollars to account for inflation. The 0.56% figure was derived because the Legislature determined that this amount represented the increase that would be realized from the sales tax on automobiles, tires, and those kinds of things. That bill was looking very good, but was filed away at the last minute because that growth factor was too controversial. Instead, they moved $90 million of general fund money into the Centennial Highway Fund, to help pay debts. This will not be used to generate new projects. That money is now being carried in another bill, called the Bill of Bills. I spent this morning trying to trace the bread crumbs through all these bills, trying to track the money. So, we ended up getting $90 million additional into the Centennial Fund, above the $59.5 million base funding. What that means is that we will be able to pay our debts sooner. We need to verify with bond counsel that we can pay these off earlier ("early call options"), since the various bonds are very complicated and diverse. But, it appears that we will be able to pay our debts by 2014, and we will start to realize positive cash flow into transportation by 2009. So, the Transportation Commission will be able to start programming additional projects when that money starts to come in 2009. This

is a significant amount of money, not a trivial amount.

There is another piece of funding, an additional $30 million dollars, that is one-time money. We would only get this money this year. That money came across with Senate Bill 3, a supplemental appropriations bill, and was to be moved from the general fund into the Centennial Fund. HB 18 moved it from the general fund into the Transportation Investment Fund, where the Transportation Commission would have the ability to program this $30 million. HB 18 didn't make it. So, there is another Bill of Bills on the House side, HB 301, that appears to move it from the Centennial Highway Fund to the Investment Fund, but there may be a technical error there, so the jury is still out as to how we will be able to use this $30 million. I still think that the Commission will be able to program that money. So we got a lot more money, which is a great thing.

State employees will see a 2.5% COLA increase, and there will be some market adjustments, where certain positions will be evaluated and benchmarked against similar positions in the private sector, and adjusted accordingly. We think there will be a one or two step raise available for some positions. Not every position will see that, and we won't know which positions will be affected for another week or two. We are still working on that.
A couple of things on the technology front. Greg Herrington is working on our GPS network, trying to create a stationary GPS network around the entire state. This is an advance that will make us the only state in the country to be in this position. This will help every surveyor, not only in UDOT but in the private sector and other public sector surveyors. They will be able to tie into this stationary network, which should provide a huge cost savings for all of our operations. That was not completely funded, but was allocated $375,000. So we will be working with other state agencies to try to implement this network. Pretty quickly we should have a stationary GPS network for most of our urbanized areas in northern Utah, which will be a great thing for us.

We spend a lot of time killing bills at the Legislature, too, and we were successful at that, as well. Another significant bill was Senate Bill 25. This bill had a lot of pieces to it. It had five pieces that will help the way we do business here in the state. One item in there that was the most controversial, and could have been the boat anchor that would not let this bill go through, this was the jurisdictional transfer. This bill got unanimous support out of the House late last night. This will set up a task force at the Legislature, with membership from the Department, to discuss jurisdictional transfer of roads. In statute today, there is a criteria that defines what should be a state road. A state road is not a local road. Most of us drive roads today and wonder why a certain road is a state road. There is a lot of history behind every one of those. We have about 1400 miles in our 6000-mile road system that don't meet the criteria as a state road. We haven't been able to transfer those to the local jurisdictions. The problem is defining how much money should go with that local road. So, this task force will be working over the next year to try to affect those transfers and define how much money will go there. That is a significant portion of SB25.

Other pieces of this legislation that we really like include: 1) If a town or city is going to have a development that will have a significant impact on traffic, and we have defined in the statue what that means in terms of numbers of vehicles, they have to inform the Department of Transportation what they are doing. We then have the opportunity to provide input to the elected officials at the local level about what that decision that they are about to make means to

the transportation system. This is one of those things that we have been working on. I think a lot of people are aware of the situation at Eagle Mountain / Saratoga Springs, a dynamic that is occurring in northwest Utah County. A brand new city is being created out there in western Utah County that we didn't know much about. All of a sudden we have this huge transportation problem that the locals are looking for us to solve, and we have no money to solve it. So, this will provide us a dynamic discussion avenue to be able to talk about this situation much sooner. Hopefully we can help people make better decisions. Would this have made a difference there? I don't think so, but it might have.

The bill also gave the Commission the ability to implement toll roads on new capacity roadways. This is a huge step. Before this, the legislature had to make that step. Now, the Department, in conjunction with the Commission, can make the decision on whether to toll a new roadway that we have built. It allows the Department and the Commission to make the decision to create HOT lanes, High Occupancy Toll Lanes, on our existing HOV system. This is another huge tool given to the Department by the Legislature.

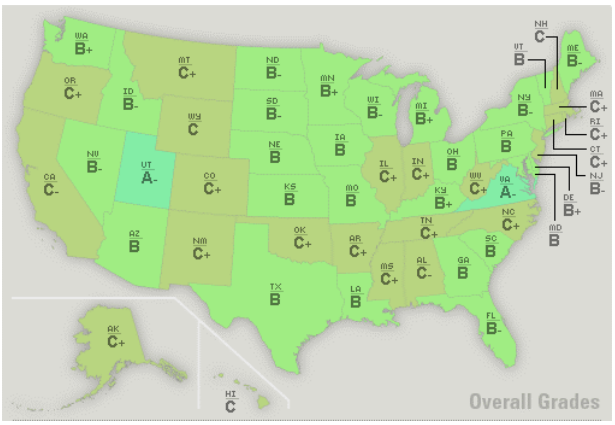
Finally, the prioritization process. The Legislature, during the creation of the Centennial Highway Fund, picked 42 projects, (41 projects plus the I-15 reconstruction) as a laundry list. They picked those projects, told us how much they would cost and what the concept was. Every year we have been going back and saying "If you want us to build it from here to here, and this is what you want us to do, this is what it will cost." That was a real eye-opener. The task force said they have to get out of the business of picking projects, or determining scope. They want the Commission to pick the projects and define the scope, but they want the Commission to have a documented, criteria-driven selection process, in order to determine which projects we should be doing, with the new money that will be coming to the Department. So, Ahmad Jaber and his folks up in Program Development have been working very hard on defining this process, working with the Commission on this, taking them through the step by step procedure. Ahmad will be making a presentation to the JPAC Committee today on this selection process, to present to the Commission as well. So, that is another piece that will be coming, and you will see these types of discussions in our Commission meetings in the future.

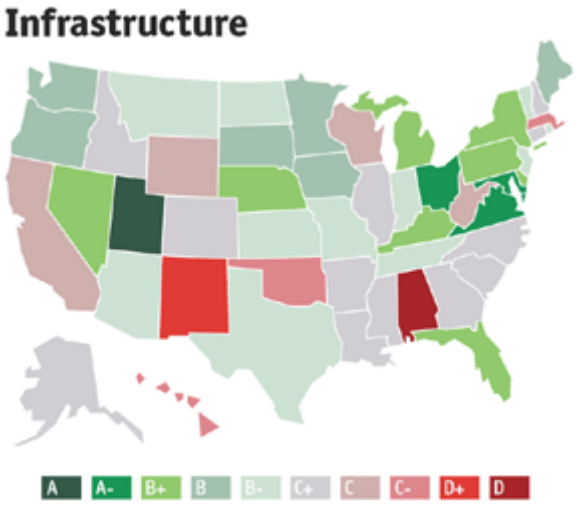
Nationally I think most people realize that we are operating under another continuing resolution for our federal funding. We don't have a highway bill. We haven't had one since Sept 30, 2003. We have been working on these continuing resolutions. We get them in either one or two months, or three or five month blocks of money. So, they say, "you now have five-twelfths of the money available to you now. Go and decide what projects you are going to do." It is very difficult for us to plan projects; very difficult for us to even know how much money we will have to obligate at the end of the year. We get ourselves in this crisis mode at the end of our federal fiscal year, Sept 30, of trying to obligate the money that we receive from Washington. We want to know ahead of time, five or six years ahead of time how much money we are going to have so the Commission can program those dollars, so we can have our projects ready to go. This is a big issue for us.

The existing continuing resolution that we are operating under right now expires at the end of May. John Njord has been back in Washington the past several days meeting with our congressional delegation, and several of the committees of congress, telling them how important it is that we have reauthorization. The House yesterday marked up a bill, TEA-LU. This is a $284 billion dollar bill, which is less than the House bill that came out last year, which was

$318 billion. To be honest with you, at the $284 billion figure, with the amount of earmarks that we are seeing in the House bill, we are probably not going to keep up with inflation with the federal dollars, if this is the amount that comes down. The President last year supported an amount of $254 billion. He has moved up to the $284 billion number, so we now at least have the House and the President agreeing on a number. We need to see where the Senate comes in. Indications are that the Senate is going to come down to that number, and we might actually get a bill. If we get it by the end of May I will be surprised; we will probably get it a little later than that.

I want to talk a little about why it is so important that you are here to do what you are about to do here today. Let me first talk about this slide that you can see up here. This slide represents a report card of all the states. And it is a pretty important effort. Every three years, *Governing* magazine does a report card on every state in the country. This year their focus was on people, ITS (how we get information technology), how we manage our money, and infrastructure. Well, guess what? Infrastructure was about 95% percent UDOT. As a state, we ended up with an overall grade of A-. You can look around the map in this slide, and Virginia was the only other state that had an "A-" grade. Five states were given a "B+" grade. If you look at how the states rated on infrastructure, you will see that Utah had the highest grade in the entire country. We had an "A". That grade comes down to several things that they keyed on, that they felt were very important. The fact that we have strategic goals that John Njord has given us, that are clear, understandable and drive us toward things that help us to maintain our infrastructure: Taking care of what we have, making it work better, improving safety, and increasing capacity. Our focus on asset management, our performance measures - they like all of those things. They think we are managing and running this Department of Transportation better than any other DOT in the country. As I travel around the country and talk to people in other states, other DOTs, about what they are doing and listen to them about what they consider to be innovation and what I consider to be the standard practice, it is amazing. I keep saying, "how can little Utah be so far ahead of everyone else?" Well, it is largely because of what you guys are going to be doing here today. It is about the innovation that you provide, the foresight, in saying "we need to try something different."





One of the things that government is great at doing is growing, growing programs. If you want me to build this new road, I am going to need more people. I am going to need more equipment. Government agencies are famous for growing programs. Every time somebody asks you to do something new, the response is

that it is an add-on. That is not the philosophy that we have here at the Department of Transportation. When we have the opportunity, if someone leaves our employment, if we have an empty position, what we ask is "what is the most important thing we are doing? Should we change what this position has been doing in the past?" There is an amazing number that I was able to tell Legislators this session, that just shocked them. Ten years ago we had three more employees in the Department than we have today. Think about what we are doing today, what we have done over the last ten years, versus what we did ten years ago. We have three less FTE's in our organization. What else are we doing? During that same period of time, we added the Ports of Entry function. We had never done that before then. That's over 75 people working in the Ports of Entry, added on. We added the Traffic Operations Center. We re-built I-15. We have created the Project Manager function. Think of all the things that we are doing differently today, that we were not doing before, and we are doing it with three less people. How are we doing that? There's only one way. We have changed the way we are doing business. We are not doing things the same way. We are thinking of new ways of doing it. Think about design-build. Could we have re-built I-15 with a core group of 12 to 15 UDOT people? We couldn't have done that with our traditional design-bid-build process, but we were able to do it with design-build, and we were able to deliver the project faster and with incredible quality. Innovation. We did something different, we tried it in a different way. Look at the things that were done on I-15 that had never been done before: the use of two-stage MSE walls. I remember sitting in these UTRAC meetings, more than ten years ago up at Utah State, and we started talking about MSE walls. Pretty innovative stuff. "Maybe we should try some MSE walls," we said. And here we are pushing MSE wall technology to the extreme, and getting settlement out there faster than ever seen before.

We used post-tensioned girders out on our structures on I-15. We haven't done that before, but it allowed us to construct those projects so much faster.

We did two prefabricated bridges out on I-215 and up in Coalville. We learned a lot from that. We are going to continue to use prefabricated bridges, or as Jim McMinimee likes to say, "Lego Bridges."

Cable Barrier. This is simple technology. Region 3 had a problem on I-15 in Utah County, and it was crossover accidents. People were dying in head-on collisions. I think that they have prevented over 40 cross-over accidents that probably would have resulted in fatal accidents, just over the past year and a half because of the installation of those cable barriers. Our fatalities, which were over 300 people on our state roads the year before last, have dropped. It has dropped to below 300. These are going down, with the vehicle miles driven increasing rapidly. We are fighting a dynamic of increasing traffic but we are driving down fatalities. Tremendous success, with the use of something that is innovative.

We are moving quickly in the asset management area. We are using asset management to help us identify where the best place is to put our money on a strategic level. It is going to be one of the most important tools we have, not only to determine where to put our money, but being accountable to the public and elected officials in how we use that money, being able to show the results of those decisions of where the money goes.

We have done some amazing things. These are the things that allow us to optimize our performance at such a high level with fewer employees. So we are not doing today what we did

five years ago, or even three years ago. We are doing things differently. And, guess what? What we are doing today, it is not the way we will be doing it in five years. We have to change. We are going to be continually evolving, looking at different ways to do things. Looking at ways to be more efficient. Where do these things come from? They come from you guys here today. What you are going to be thinking about, what you are going to be brainstorming, every day, day to day, you are faced with challenges and problems. How are we going to solve them? Be thinking and asking questions, get involved. Don't just say, "I am going to do this the same way I did it before because it is safe. I know how to do it." Push the envelope, ask the question: "Can I do this differently? Are other people doing this differently?"

Like Shana said, use research as a tool, something that you can use to do your jobs better. I am really excited that you are going to be sitting here today, brainstorming, and what you are going to be talking about here today is, I am convinced, going to create the basis of how we do business in the next five years, in this Department. Be thinking about how this place should be operating. The public expects it of us. So, take this time away from the office, and be thinking about how you are going to be innovative. I want you to push the envelope.

I want to thank you all for being here today. Thank you for your energy. No idea is a bad idea. I think you all understand the brainstorming process that you are going to be going through today. Listen to people, help people, flesh out ideas, and just have a great time. It is really fun working with different people and learning from them. Everyone is going to come away here today better than when they walked in this door.

Thank you for having me here for a few minutes, and have a great day.

Other Activities and Presentations

Rukhsana Lindsey, Engineer for Research and Development: Acknowledgements

Shana Lindsey thanked Carlos, and commented that we were going to have a lot of fun at the workshop today. Shana also thanked the Research staff for the effort required to put the workshop together, and recognized Blaine Leonard as the chair of that effort.

Blaine Leonard, Sr. Research Project Manager: Introductions to Technical Presentations

Blaine Leonard introduced three technical presentations to be given during the workshop. Each of these presentations was given at the Transportation Research Board (TRB) conference held in January 2005 in Washington, D.C. The TRB conference is attended by thousands of transportation professionals from all over the country, including a contingent of people from UDOT. UDOT's leaders felt that the five presentations given by UDOT representatives during the TRB conference should be shared with the research-oriented attendees at UTRAC. These presentations represent successful research and implementation efforts, and innovative improvements to our operation. Three presenters were able to attend the UTRAC workshop and give their presentations at various times during the day, as indicated below.

TeriAnne Newell, Project Manager: Mountain View Corridor Public Input

Teri Newell has been heavily involved for some time on the Mountain View Corridor project, in western Salt Lake County. Teri related how she has been traveling around the Wasatch Front making presentations to, and listening to, the public about the various options for this future transportation corridor. She has gained some real insight about dealing with the public, and getting effective public input, and shared those insights with the group.

The full text of her presentation is included in Appendix D of this report.

Chris Glazier, GIS Specialist: Vehicle Detection and Classification Using Model-Based and Fuzzy Logic Approaches

Automatic vechile classification systems currently in use have severe deficiencies, including: low accuracy, very specialized requirements, and fixed orientation of the camera. Chris Glazier has been working with Dr. Hengda Cheng of Utah State University on a model-based, fuzzy logic system, which potentially overcomes these deficiencies. This system has been tested using a variety of images captured by UDOTs traffic operation cameras, with very promising results.

The Fuzzy-logic approach uses a two-dimensional photographic image of a vehicle which is pre-processed to eliminate noise, fuzziness, and abnormal contrast. The system then estimates the length, width, and height of the vehicle, and the number of axies. The Fuzzy-logic component of the analysis comes into play to deal with ambiguity and uncertainty in the images. Although the processing algorithm is complex, computing time is about 35 milliseconds per image, which is adequate for “real-time” processing. Accuracy of this approach was shown to be over 98 percent.

This new method of vehicle classification has been shown to be fast, accurate, and more flexible that current methods. Special camera orientation is not needed, so images can be obtained from routine camera operations without disrupting normal traffic operations and incident management functions.

The full powerpoint presentation given by Chris Glazier is included in Appendix D of this document.

Clifton Farnsworth, Geotechnical Field Engineer: Long-Term Instrumentation Program to Monitor Various Geo-Technologies Used on the I-15 Reconstruction Project

Since the re-construction of I-15 through the Salt Lake Valley in 1997 through 2001, UDOT has been monitoring the performance of innovative geotechnical applications used on this project. Clifton Farnsworth has been closely involved in this monitoring effort with Dr. Steven Bartlett at the University of Utah. The intent of this work is to assess the adequacy of each of the innovative methods used and to make recommendations for future applications of these various methods.

The innovative geotechnical employed in the I-15 Re-construction project included: prefabricated vertical drains (wick drains), surcharge preloading, 2-stage mechanically stabilized earth (MSE) walls, lime cement columns, and expanded polystyrene (EPS) Geofoam lightweight fill. With the exception of surcharge preloading, these methods had seen little or no application in Utah prior to this project. These methods were all employed to accelerate and limit the large amount and long duration of primary and secondary settlements in the soft soils along the highway corridor.

Since this monitoring program has a 10-year duration, the challenges included selecting the appropriate instrumentation, placing the instrumentation in locations that ensured survivability and continued access, determining the level of accuracy needed, staying within reasonable budgets, and developing a sustainable plan for collecting and interpreting the data. A suitable plan was developed, the instrumentation was installed, and readings have been gathered on a fairly regular schedule. Clifton indicated that some instruments were destroyed during construction, so providing protection and redundancy are important and some repairs should be anticipated. Grouping instruments makes periodic readings more convenient.

The full powerpoint presentation given by Clifton Farnsworth is included in Appendix D of this document.

Blaine Leonard, Sr. Research Project Manager: Outline of the Workshop Agenda

Blaine Leonard thanked participants for attending, and outlined the agenda for the workshop. Since the workshop format has changed considerably from previous years, he outlined the process used to evaluate and modify the workshop process. He thanked the team who developed these changes, the group leaders who stepped up early to make the process work, and the Research staff who helped organize the workshop.

Blaine also outlined the logistics of the schedule, including introducing the leader and research staff contact for each discipline group, indicating the location of the breakout rooms,

and discussing the activities which would take place during each session. He described the new process of pre-submitting Problem Statements, and indicated that 80 statements had been submitted for review. He stressed the importance of discussing the scope of each project in detail, fully evaluating the desired end product, and determining if the UDOT champion was committed to the project. He described the voting process, which was considerably different than in previous years, and indicated that top priority projects from each group would be listed for funding before lower priority projects.

Blaine suggested that attendees could visit groups other than those they were assigned to, and could interact during breaks to find out of projects of interest were being discussed in other groups. He encouraged sharing information and ideas between attendees.

UTRAC Trailblazer Award

The 11th UTRAC Trailblazer Award
for Outstanding Contributions to Transportation Research

2005 Recipient

Mr. Stan Burns, P.E.

Award Citation - Presented by Rukhsana Lindsey, Engineer for Research and Development

First, I would like to read all the names of the people who have received this award in the past so that you can appreciate all the good minds that have won this, people who have helped Research at UDOT improve. These people are:

Wade Bentensen, 1994.
Howard Richardson, 1995.
Dale Peterson, 1996. I'm sure most of you know him.
Doyt Bowling, 1997. He is here with us today.
William G. Grenney, Utah State University, 1998. You all know Bill.
John Gunderson, 1999. He's one of my favorite men. He was the Region 1 Maintenance Engineer for a long time. He has contributed his

efforts towards Research, many, many times.
Tom Warne, 2000.
Loren R. Anderson, Utah State University, 2001. I'm sure he is here today.
Doug Anderson, 2002. Doug was the Engineer for Research for a long time and he's improved the Research community a lot. He's well known nationally. When I went to TRB this year, every body knew Doug and they wanted me to tell him hi. Thank you, Doug, for all your efforts.
Jim McMinimee was the last person who received this award and that was in 2003. Jim has always been involved with UTRAC and had great ideas that he has brought to Research.

With that introduction, I'd like to present this UTRAC Trailblazer Award for 2005 to Mr. Stan Burns, P.E., the UDOT Engineering Services Director and recent past Engineer for Research and Development.

Acceptance Remarks - Stan Burns, P.E., Director of Engineering Services, UDOT:

Shana asked me to say a few words. She gave me a lot of notice, like a half an hour, so I was going to say a few words of thanks for this award.

I wouldn't be standing here today if it wasn't for all of you here in the audience. I'd like to recognize some of the team that put me here, accepting this award today. The Research Group at UDOT: Elaine Chatfield, Doug Anderson, Blaine Leonard, Dan Hsiao, Abdul Wakil, Michelle Page, Robert Stewart, and Barry Sharp. I think I got all of you. Thanks a lot guys.

Second, I would like to thank Paul Mooney. Paul Mooney is from FHWA; he's been our liaison with FHWA for five years now. I couldn't ask for a better partner. Thanks Paul. Third, everybody at UDOT: all the division heads and all the staff of all the divisions, who have been coming to UTRAC and brainstorming ideas, and then go back and serve on technical advisory committees and implement all these good ideas. We are only successful in research with your help.

Finally, I would like to thank the universities. The universities have changed a lot over the last couple of years. They understand the importance of schedule, getting projects done on time for our customers, and then second, they understand the importance of implementation. This surprised me when I was in Shana's position because we all went to college and we think of our university professors as people who want to study some very esoteric ideas. But they said, "No, not at all, we don't want to do that at all. We want to do practical research. We want our graduate students to do practical research." And then best of all, what surprised me was, they said, "When we do good research, we are not happy unless you implement it at UDOT." So they have come around a lot over the last four or five years. I thank you a lot, universities.

I would like to say a few words about research and change. If we are going to be a better UDOT, we need to use the resources of everybody we have. And I'll start with a quote from John F. Kennedy. He said, "Change is life. And for those who only see the present or the past

will miss the future." There's a story I used to tell the maintenance guys when I was in maintenance. They would ask, "Why are we doing this new technology?" And this is the story I would tell them. The most impressive feat in my lifetime, engineering wise, was the Apollo Moon Landing. If George Bush today said to us, "We're going to be on the moon at the end of the year, or the end of the decade," we wouldn't pull out a Saturn rocket. We would use the latest technology of today. We would take ideas from other countries. We would take ideas from research universities, and we put men and women on the moon at the end of this decade safer, faster, and cheaper. The same thing applies to us at UDOT. The UDOT of tomorrow will be smart roads with smart cars, multi-modal, and new materials. How are we going to get there? The only way we are going to get there is if we take good ideas from other states, other countries, we take good ideas from you, and we take good ideas from universities. And so, finally, in closing, Research can provide you with those tools. Whether it's NCHRP studies, going to the Transportation Research Board annual meeting, or sitting on technical advisory committees, we are all working together to implement the good ideas you are going to produce today.

I just want to say thank you again for this award. I wouldn't be standing here if it wasn't for the team. I consider all of you the team so thanks a lot.

RESEARCH PROBLEM STATEMENTS

Each issue considered during the UTRAC workshop is described in a "UTRAC Problem Statement" form. The statements are prepared and submitted prior to the workshop. The form includes the objective of the proposed research, the steps anticipated to meet the objective, the approximate budget needed to perform these steps, the deliverables desired, the challenges and hurdles anticipated during the work, the key champion within UDOT who will monitor and use the results of the work, and other individuals and organizations are interested in the research efforts.

Problem Statements Prioritized For Funding

During the UTRAC Workshop, each discipline group discussed and prioritized the Problem Statements submitted to their group. The three to six highest priority Problem Statements, in order, were submitted to the Research Division for potential funding. The complete list of Problem Statement considered by each group is shown in the next section of this report, along with the priorities assigned to them. After matching the available fiscal year 2006 research funding (from federal State Planning and Research [SPR] funds and state Construction funds) with the list of priorities, a list of 21 Problem Statements resulted. Four additional projects were added to list based on the strategic needs of the Department, as determined by UDOT senior leaders during the process of reviewing the list of Problem Statements.

The 25 Problem Statements ranked for funding are shown below, including the funding priority, the Problem Statement number and title, the UDOT champions, the discipline area each falls within, and the approximate budget anticipated. Problem Numbers indicated with an "AM" represent the "administratively mandated" projects identified by UDOT's senior leaders. The research funding allocated to these projects is $1,180,500.

Following this list, the full text of each Problem Statement is given, in order of funding priority.

Funding Priority	Prob No.	Problem Title	Champion	Approx Budget
1	05.01-1	Mitigate Queue Lengths in Work Zone Traffic Control	Pete Negus/Construction	$50,000
2	05.02-02	Cost-effectiveness & Indicators-Pavement Rejuvenation	Scott Nussbaum/Maintenance	$80,000
3	05.03-4	Full-Depth Recycling and Stabilization of Pavement Base Layers	Nathan Lee/Materials	$100,000
4	05.04-6	Design Methods for Unique Culvert Installations	Denis Stuhff/Hydraulics	$35,000
5	05.05-7	Extract Vehicle Classification from TOC Video	Chris Glazier, Richard Manser/Planning	$34,000

6	05.06-6	Advanced Warning Signal Site Selection Evaluation Matrix	Mack Christensen/Traffic	$35,000
7	05.07-3	Dynamic Passive Pressure on Abutments & Pile Caps	Bischoff, Boyle, Sjoblom/Geotechnical	$75,000
8	05.08-1	Improvement of Deck Concrete Mix Design and Curing Practices	Todd Jensen/Structural	$70,000
9	05.01-3	Worker Visibility	Darrell Giannonatti/Construction	$25,000
10	05.02-06	Skid Index Trigger Values	Bill Lawrence/Maintenance	$10,000
11	05.03-1	Asphalt Binder Uniformity	Kevin VanFrank/Materials	$90,000
12	05.04-2	Bridge Scour Countermeasure Phase II	Michael Fazio, Denis Stuhff, Tim Ularich/Hydraulics	$42,000
13	05.05-3	Access Management Performance Index	Tim Boschert/Planning	$35,000
14	05.06-7	Access Management/Traffic Impact Analysis Training	Tim Boschert/Traffic	$30,000
15	05.07-2	Programming of Strong Ground Motion Instrumentation of New Bridges	Jim Higbee/Geotechnical	$30,000
16	AM.05.001	Evaluation of Effects of Stay in Place Forms on Bridges	Todd Jensen/Structural	$50,000
17	05.04-1	Design & Development of a Context Sensitive Visual Resource Assessment and Management (VRAM) System for UDOT	Terry Johnson, Lars Anderson/Environmental	$88,000
18	05.02-07	Targeted and Adaptive Simulator Training for Winter Maintenance	Richard Clarke, Shana Lindsey/Maintenance	$10,000
19	05.05-11	Determination of Crash Costs for Use in Benefit/Cost Analysis (Value of Life)	Jim McMinimee/Administration	$25,000
20	AM.05.002	Evaluation of Rapid Mapper Technology	Lisa Wilson/Roadway Design	$42,000
21	AM.05.003	Older Driver Study: Evaluation of Safety Effects of Pavement Markings and Signage	Administration	$80,000
22	AM.05.004	Pavement Marking Study (Test Sections)	Shana Lindsey/Maintenance	$5,000
23	05.05-10	Good Roads Cost Less	Kim Schvaneveldt/Planning	$20,000

24	05.03-3	SMA Paving Mechanistic Properties	Rodney Terry/Materials	$100,000
25	05.07-6	Geophysical methods to prioritize mitigation options for SR-9 in the Coal Hill landslide area	Leslie Heppler/Geotechnical	$19,500

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RESEARCH PROBLEM STATEMENT

Problem Title: Mitigate Queue Lengths in Work Zone Traffic Control **No.: 05.1-1**

Submitted By: Darrell Giannonatti and Doug Anderson **E-mail:**

1. Briefly describe the problem to be addressed:

Queue Lengths in Construction Work Zones lead to traffic delays, air quality issues, accidents, road rage, etc. UDOT needs additional tools to mitigate traffic ques in construction work zones.

Strategic Goal: ☐ **Preservation** ☐ **Operation** X **Capacity** X **Safety** (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Recommend ITS technology to manage work zone traffic queues.
2. Recommend Performance Based specifications to manage work zone traffic queues.
3. Recommend Innovative Contracting methods to manage work zone traffic queues.
4. Recommend applying above objectives to interstate and arterial roads.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Conduct a thorough state-of-the-art review on work zone traffic queue length mitigation. 100 hours

2. Review in detail methods that appear to be the most effective and efficient. This will include ITS applications such as requiring advanced signal construction with video detection cameras installed . 150 hours

3. Select techniques and equipment that could improve UDOT's traffic control plans and methods. 40 hours

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Contract by June, 2005.
The project will be completed by October 31th, 2005.

5. Indicate type of research and / or development project this is:

Large: X **Research Project** ☐ **Development Project**
Small: ☐ **Research Evaluation** ☐ **Experimental Feature** ☐ **New Product Evaluation** ☐ **Tech Transfer Initiative** :
☐ **Other**_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consideration will be given to either consultant or University, depending upon credibility of staff and ability to complete by October 31st, 2005.

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7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A complete report would document all aspects of the research. Identify the top three technologies and provide specifications and drawings, that could be be included in a construction project bid package.

8. Describe how will this project be implemented at UDOT.

Central Construction will work with Regions to identify proper projects for Implementation.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Work zones should be safer and more effectively move traffic through the corridor. Impacts to the public should be reduced in the form of time savings, fuel use, and crash related costs.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Project funding is always limited. Funding may not be available for State-of-the-art methods.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Pete Negus

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $50,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Region Construction Engineers (Dennis Simper, Karl Verhaeren)			
B) Members of Utah's contracting community (Rich Thorne appointed)			
C) Region traffic engineers (Brian Chamberlain or Chris Siavrakas)			
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Cost-effectiveness and Indicators for Pavement Rejuvenation **No.:**05-02.2

Submitted By: Scott Nussbaum **E-mail:** snussbaum@utah.gov

1. Briefly describe the problem to be addressed:

1 Determine the effectiveness of rejuvenating oils in extending the life of open-graded and chip seal coats.
2 Provide guidelines for conditions that indicate that rejuvenation is warranted.
3 Evaluate safety considerations associated with this application.

UDOT maintenance currently applies "rejuvenating" oil to our pavements between seal coats. The intent is to extend the life of the pavement, or the pavement seal coat. However, opinions are mixed as to its effectiveness. Rejuvenation may also temporarily affect skid resistance, and masks paint or tape lines to some degree, leading some to ask if it is worth the cost and effort.

A UDOT report MR-89-002, was completed in 1990. At the time, performance evaluation testing was not as advanced as it is now, and the Department has moved from approved proprietary agents to generic specifications, and literature suggests that the different agents may have significantly different results and even differences in optimal application rates, but to my knowledge, this has not been addressed within the department.

2. List the research objective(s) to be accomplished:

1. Determine the effectiveness of rejuvenation oils under various typical conditions on chip open-graded seal coats. Consider varying applications of standard oil types specified by UDOT maintenance contracts as well as traffic volume.
2. Evaluate safety considerations associated with the application of rejuvenation oil to include skid-resistance and obscuring of pavement markings.
3. Provide recommendations for the use of rejuvenating oils with consideration for cost-effectiveness, traffic volume, safety, and seal coat type and condition.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1.	Select control and test sections for evaluation.	300
2.	Evaluate pavement condition, skid resistance, and pavement marking retroreflectivity.	160
3.	Apply the rejuvenating oils to the test sections.	60
4.	Monitor short-term skid resistance, and marking retroreflectivity.	100
5.	Monitor Long-Term pavement performance. (4-5 yrs).	400
6.	Analyze data, provide recommendations.	160

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin during the summer of 2005, with selection and application of rejuvenation oils. Monitor skid resistance and pavement markings for 1 year.

Evaluate pavement conditions regularly for 3 years.

Provide recommendations in 2008.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University with Input from UDOT Staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A technical report detailing when rejuvenation is a benefit, and which types of oil are right for which kinds of seals, and what application rates are appropriate.

8. Describe how will this project be implemented at UDOT.

The results would significantly affect how UDOT manages approximately $1,000,000 in rejuvenation dollars annually and the associated costs of pavement striping, perhaps making a significant impact on pavement performance.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT maintenance will benefit from a cost and safety analysis by making the best decisions for pavement preservation dollars and consideration for public safety.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Scott Nussbaum, Region One Maintenance, 801-620-1637

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $80,0000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)		Nathan Lee, Region One Materials, 801-620-1600		N
B)		Scott Goodliffe, Area Supervisor, 801-620-1610		N
C)		Brian Phillips, Region 3 Maintenance Engineer, 801-227-8055		Y
D)		Bill Townsend, Region 2 Maintenance Engineer, 801-975-4929		Y
E)		Lynn Bernhard, Central Maintenance, 964-4596		Y
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

UDOT Central Materials, Region Operations Engineers

RESEARCH PROBLEM STATEMENT

Problem Title: Full-Depth Recycling and Stabilization of Pavement Base Layers **No.: 05.3-4**

Submitted By: Spencer Guthrie and Nathan Lee

E-mail: guthrie@byu.edu
nlee@utah.gov

1. Briefly describe the problem to be addressed:

The use of full-depth recycling (FDR) for reconstructing deteriorated asphalt pavements is advantageous from engineering, environmental, and economics perspectives. Last year UDOT utilized the FDR process in conjunction with cement stabilization to reconstruct Interstate 84 near Morgan. The project raised several questions about the design, construction, and performance of recycled, cement-stabilized layers. For example, what is the maximum permissible ratio of reclaimed asphalt pavement (RAP) to base? How is the optimum stabilizer type and content selected? How does one know when to open the stabilized layer to traffic? How does one quantity the benefit of stabilization with respect to both strength and durability? Research is needed to address these questions.

Strategic Goal: (Check all that apply) ☒ Preservation ☒ Operation ☐ Capacity ☐ Safety

2. List the research objective(s) to be accomplished:

1. Evaluate the effects of different ratios of RAP to base on material strength, durability and density.
2. Evaluate the efficacy of specific types and amounts of different stabilizers for improving typical Utah materials.
3. Develop specifications regarding construction methods and early trafficking and curing issues.
4. Recommend procedures for designing recycled layers.
5. Address the challenge of measuring density in the field

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours: 1500**

1. Conduct a literature review to summarize existing work related to these topics.
2. Design and conduct laboratory and field experimentation.
    a. Determine if target project subgrade is moisture susceptible and design appropriate stabilization process
    b. Evaluate sensitivity of strength and durability to rap proportions and thickness of base.
    c. Define QC requirements
3. Analyze data to formulate conclusions and recommendations.
    a. Address minimum strength gain, curing issues, compaction time, time to paving, placement temperature, time to seal
4. Scope: Four or Five field projects (2 in R1, R3 and R4 potentials), materials from those projects used in lab

4. Outline the proposed schedule (when do you need this done, and how we will get there): (12 month proposed timeframe)

Because the other half of the Interstate 84 project in Morgan will be constructed this summer, this research should begin immediately if that project is to be considered for field experimentation. The literature review and experimentation could begin simultaneously. The former might require two to four months, while the field experimentation would depend on the availability of projects. Laboratory work would require eight to twelve months to complete, with the entire project leading to up to 18 months.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Report documenting effects of different ratios of RAP to base and efficacy of various stabilizers for improving typical Utah base materials
2. Comprehensive specifications for construction based on items identified in task list
3. Design procedures, including materials characteristics and parameters, for recycled, stabilized layers

8. Describe how this project will be implemented at UDOT.

UDOT engineers will use the data and specifications for designing and constructing high-quality, recycled, stabilized pavements.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Improving the design and construction of recycled, stabilized base layers will ultimately increase the service life of reconstructed pavements, reduce haul costs, effectively reuse existing materials, decrease pavement life-cycle costs, and provide the pubic with a better pavement.

10. Describe the expected risks, obstacles, and strategies to overcome these.

None

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Nathan Lee, Pavement Management Engineer, 801-399-0351

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Rodney Terry	UDOT Region 1 Materials Lab	801-399-0351	y
B) Bruce Vandre	UDOT State Office	801-965-4835	y
C) Todd Laker	Holcim Cement	801-643-2708	n
D) Mitzi McIntyre	ACPA	801-556-9561	y
E) Larry Gay	UDOT Region 4 Materials Lab	435-896-1306	y
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Portland Cement Association, Asphalt Zipper, Idaho DOT, Rocky Mountain Concrete Promotional Council

RESEARCH PROBLEM STATEMENT

Problem Title: Design Methods for Unique Culvert Installations **No.: 05.04-6**

Submitted By: William Grenney **E-mail:grenney@cc.usu.edu**

1. Briefly describe the problem to be addressed:

Current Highway Culvert design practice is based upon the Federal Highway Administrations Design Manual, HDS-5. The HDS-5 manual is now over 30 years old and coefficients adopted for use were based on limited small model tests and did not address the design issues of important non-traditional Culvert installations such as "Fish Friendly" design. A great deal of significant research has been done in the last 30 years on Culvert performance, including full scale and large scale modeling of both traditional and non-traditional Culverts which is not captured by either HDS-5 or the FHWA Culvert computer model, HY8. HY8, because it was also developed 30 years ago and still relies on DOS computational algorithms, is extremely difficult to apply. Similarly it simply incorporated the now obsolete design methodologies and standards from HDS-5 into the computer model. Many State Departments of Transportation including UDOT lack user friendly and accurate software tools for the design of non-traditional and traditional Culvert installations. There is a need for the development of a design methodology that conforms to FHWA standards and which also incorporates the latest information and research results. The methodology should be complementary with the WMS watershed software that is currently being used by UDOT and several other DOTs.

2. List the research objective(s) to be accomplished:

1. Literature review on design criteria for non-traditional culvert installations including research work currently underway at the Utah Water Research Laboratory.

2. Development of a computer based tool that incorporates current FHWA design standards and extends the scope to include the non-traditional installations.

3. Software, final report and training seminar.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Conduct the literature review and summarize the results (2 wks professional, 4 wks student)

2. Develop a prototype computer program that incorporates current FHWA design standards and also criteria for non-traditional culverts. Present the prototype to the TAC committee for approval (4 wks professional, 24 wks students)

3. Develop the final software deliverable. (2 wks professional, 24 wks students)

4. Develop the final report including discussion on the models complementary use with WMS. (1 wk professional, 3 wks students)

5. Prepare and present a training seminar (1 wk professional, 1 wk students)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

July – Sept 2005 Literature review
Sept – Dec 2005 Prototype development and TAC approval
Jan – April 2005 Final design and development
April – June 2005 Final Report and Seminar

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A. Practical design software

B. Final Report and user guide

C. Training Seminar

8. Describe how will this project be implemented at UDOT.

The computer based design tool will be distributed royalty free to UDOT

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Improved efficiency and economy for culvert design for both traditional and non-traditional culvert installations

10. Describe the expected risks, obstacles, and strategies to overcome these.

None anticipated.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Denis Stuhff of UDOT Central Hydraulics

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)		Michael Fazio of UDOT Central Hydraulics		X
B)		Tim Ullarich of UDOT Central Hydraulics		X
C)		Jerry Chaney of UDOT Environmental Division		X
D)		Marco Palacios UDOT Hydraulic Engineer Region 3		X
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA and other state DOTs

RESEARCH PROBLEM STATEMENT

Problem Title: Vehicle Classification from TOC Video **No.:**05-05.7

1. Briefly describe the problem to be addressed:

Extract Vehicle Classification from TOC video into useful format for use by Data Collection Personnel and Pavement Design Engineers.

Strategic Goal:	9 Preservation	9 Operation	9 Capacity	9 Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. This Project is to Implement successful preliminary UDOT research by capturing and recording TOC video split off normal camera video stream. This project is to demonstrate successful real-time classification of vehicles in the video. Video is to be collected from various lighting conditions.

2. Vehicles in the videos are to be counted and classified manually and automatically and the results tabulated for comparison.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Meet with TOC IT and Transcore on hardware recording to DVD (plus$2000equip.)	10hrs	$4000
2. Obtain test video under many light and weather conditions	40hrs	$2000
3. Have USU dept of Computer Science extract vehicle classifications (processing and modification to equations if required. (training of software)	240hrs	$26000
4. Manually classify vehicles in captured video	80hrs	in-house
5. Compare automated results with manual tabulation of the same captured video	80hrs	in-house
6. Acquire video for 24hr period and demonstrate live processing in AVI of system	10hrs	$1000
7. Write Validation Report that includes accuracy under various traffic and light conditions	80hrs	in-house
total	540hrs	$34,000

4. How will this project be implemented? (e.g. training, equipment, software, hardware, field demos, workshops, etc.) Actual streaming video will be processed, data extracted and binned for 15min and 1 hour segments.

9 Improved asset	9 Crashes reduced	9 Environmental benefit	9 Enhanced efficiency	9 Other

Improved data for asset management and Design

Improved safety for personnel

Higher accuracy for classification and longer duration of counts provide better statistical validity

(Please fill out other side of sheet as well.)

5. What deliverable(s) would you like to see? (e.g. useable technical product, technique, policy, procedure, specification, standard, software, training tool, etc.)

Report on the validity of video automated classification. Under what circumstances (weather, light, traffic vol.) does it do well, and when it fails.

6. Who in the Department could be the direct end-users of this study=s results?

Pavement Management Engineers
Planners
Data collection crews

7. How could the Department benefit from implementing the results of this study?

HPMS reporting to FHWA
Pavement Designers would have better data for overlay and pavement design

8. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $34,000

9. List the potential champions (people interested in and/or willing to participate in the Technical Advisory Committee for this study):

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)		Chris Glazier	965-4381	Y
B)		Hengda Cheng Utah State University		N
C)		Samuel Sherman ITS		N
D)		Richard Manser ITS		Y
E)		Doug Anderson	965-4377	Y
F)		Todd Hadden Program Development		Y
G)		George Ramjoue WFRC		Y

10. Identify other Utah agencies or groups that may have an interest in supporting this study: WFRC

9 City 9 County 9 MPO 9 Research Organization 9 Private Industry 9 University 9 Other

List names:

11. Identify other regional/national agencies or groups that may have an interest in supporting this study:

9 FHWA 9 USGS 9 EPA 9 NCHRP 9 TCRP 9 State DOT=s 9 Other

List names:

RESEARCH PROBLEM STATEMENT

Problem Title: Advance Warning Signal Site Selection Evaluation Matrix **No.: 05.06-6**

Submitted By: Mack Christensen (UDOT)/Grant Schultz (BYU) **E-mail:** mackchristensen@utah.gov gschultz@byu.edu

1. Briefly describe the problem to be addressed:

UDOT has installed advance warning signals (AWSs) at three locations on Bangerter Highway, one location on S.R. 201, one location on U.S. 89, and one location on SR-18. The intent of these installations is to improve safety by providing advance warning to drivers of the change in signal indication. Early installations were evaluated in a previous study, while the current installations on Bangerter Highway are under evaluation to determine their effectiveness and draft guidelines are currently being developed through a technical advisory committee to guide future installations. The purpose of the proposed research would identify potential locations for future AWS installation based on the guidelines and effectiveness identified in the current AWS evaluation project. One tool that would be used in identifying future AWS installations is the GIS enabled web delivered data almanac. The databases included in the almanac include crash, speed, geometric conditions (i.e., horizontal and vertical data), and AADT data. This tool would be used to pinpoint high crash locations that could then be evaluated further using a site selection evaluation matrix to identify locations that meet the guidelines identified. This project would provide an opportunity to follow up on current research by establishing a site selection matrix and subsequently identifying candidate locations for future installations to aid in improving the safety and efficiency of the highway network.

Strategic Goal: ☐ Preservation ☒ Operation ☒ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Application of advance warning signal guidelines and identification of candidate AWS installation locations.
2. Utilization of the GIS enabled web delivered data almanac to identify high crash locations.
3. Comparison of candidate locations with current AWS evaluation results and guideline criteria.

3. List the major tasks required to accomplish the research objective(s): 9-12 month Estimated person-hours 1,500

1. Finalize AWS installation guidelines.
2. Identify high crash locations using the GIS enabled web delivered data almanac.
3. Further evaluate high crash locations to identify locations where AWS installations may prove effective.
4. Use matrix to evaluate existing installations.
5. Establish technical advisory committee to evaluate candidate locations based on guidelines and previous research results.
6. Identify candidate sites for AWS installation.
7. Develop standard drawing for typical installation.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

It is recommended that this project begin in early January 2006 with the data-mining portion of the project.

A list of proposed sites would be identified and evaluated by the TAC during the Summer 2006.

Concurrent to this process, the evaluation matrix would be established and the guidelines refined based on the new research.

At the end of the Summer 2006 the results would be tabulated final recommendations made for future installation.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative
☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff joint participation.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables expected from this project would include: 1) refined guidelines for AWS installation based on the analysis; 2) evaluation matrix; 3) identification of high crash locations on state roadways; 4) sub-identification of intersections that meet AWS installation guidelines for future AWS installation; 5) development of a standard drawing; and 6) documentation of observations, results, and recommendations.

8. Describe how this project will be implemented at UDOT.

This project will be implemented at UDOT through the traffic and safety program. The results of the study will be very useful in identifying high crash locations with the potential for installation of AWS devices to provide improvements in safety statewide.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from this project through an increase in the safety and efficiency of candidate AWS installation locations. This would include a reduction in the number and/or severity of crashes, a reduction in red-light running violations, and an overall improvement in the driver experience. This project will also standardize AWS installations statewide.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Mack Christensen, UDOT Region 2 Operations Engineer, (801) 975-4827

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Grant Schultz	Brigham Young University	(801) 422-6332	
B) Deryl Mayhew	UDOT Region 2 Signal Engineer	(801) 887-3605	
C) Ritchie Taylor	UDOT Region 2 Traffic Engineer	(801) 887-3717	
D) Doug Bassett	UDOT Region 3 Traffic Engineer	(801) 227-8019	
E) Troy Torgersen	UDOT Region 4 Traffic Engineer	(435) 893-4707	
F) Robert Clayton	UDOT Safety Programs Engineer	(801) 965-4521	
G) Darin Deursch	UDOT Region 1 Traffic Engineer	(801) 620-1607	

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Salt Lake County, FHWA, and Other DOTs.

RESEARCH PROBLEM STATEMENT

Problem Title: Dynamic Passive Pressure on Abutments & Pile Caps

No.: 05.07-3 (also 05.08-3)

Submitted By: Kyle Rollins and Travis Gerber, BYU Civil Engineering **E-mail:rollinsk@byu.edu**

1. Briefly describe the problem to be addressed:

Various design recommendations are given for the passive force-deflection relationships for abutments and pile caps. Research suggests that resistance is substantially greater and that current recommendations are leading to costly increases in the number of piles to handle lateral load. Current UDOT specs. call for only 3 ft of compacted backfill around bent pile caps, but it is unknown how this will reduce the passive resistance relative to complete backfill. Various pile cap connections are presently used but very little guidance is available to define how these connections affect ultimate resistance and load-deflection relationships. Finally, most design recommendations ignore increased resistance due to damping which could also lead to greater economy. Full-scale dynamic tests can provide answers to these design issues and lead to significant cost savings. Testing equipment and personnel will be mobilized to Utah from California during summers 2005 and 2006 for a related study funded by NSF and can greatly reduce the cost of testing.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop passive force-deflection relationships for dynamic loads

2. Determine effect of pile cap connection details on abutment stiffness.

3. Evaluate damping coefficients for pile caps and backfills.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Construct pile caps for testing which have different width/height ratios and connection details (varying from "pinned" to "fixed").
2. Perform static and dynamic lateral load test on pile caps without backfill. (Static tests with 1300 kip actuators and dynamic tests with 100 kip eccentric mass shakers)
3. Evaluate stiffness-rotation relationship for pile caps with different connection details.
4. Perform static and dynamic lateral load tests on pile caps with compacted backfill extending three distances from the face.
5. Conduct analysis of test results to define static and dynamic passive force-displacement relationships and damping ratios for partial and complete compacted backfill cases.
6. Evaluate existing methods and recommend improvements to account for measured response.
7. Prepare final report with implementation summary.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Large eccentric mass shakers and personnel from UCLA will be in Utah in late summer 2005 and summer 2006 and can be used for these tests without mob/demob costs or major personnel time charges. The success of the project will hinge on coordinating with the availability of this equipment. Coordination will also be necessary to obtain supplemental funding from other DOTs. Ideally, the work would begin in May 2005. All field testing would be completed by mid-summer 2006. Analysis of test data would likely require six to eight months and a report would be completed at the end of the second year.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University with supervision and oversight by UDOT staff as part of technical advisory committee.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.) A report will be prepared describing the results of the field testing and the analysis of the test data. The report will also contain an implementation summary which will concisely describe the design methods developed from the field testing and provide an example of its use for a typical problem. Design recommendations for pile head connections will be provided. Results from the study will also be presented to the AASHTO bridge design technical committee on foundations for adoption in future AASHTO codes.

8. Describe how this project be implemented at UDOT.

The equations developed would be used in the design of new bridges and retrofit of old bridges by the structural and geotechnical engineers. Presentations on the use of the method will need to be provided by the researchers and a report will be available to UDOT consultants.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

By accurately accounting for dynamic passive resistance, pile foundations can be more efficiently designed which will reduce the number of piles, the size of pile caps, and the overall cost of bridge structures. In addition, the resulting structures will have increased safety against earthquake damage. Potential cost savings of pile foundations could be in the 20-40% range. There are also potential cost savings in the superstructure design.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The costs associated with this project are relatively high but other state DOT's have expressed willingness to participate in a pooled fund project, thereby leveraging the cost to UDOT. Final commitment will require recruitment by UDOT and university personnel. The testing cost can be minimized if performed in summer 2005 and summer 2006 when 200 k capacity eccentric mass shakers from UCLA will already be mobilized to Salt Lake for related field testing.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Jon Bischoff, Hugh Boyle, Darin Sjoblom

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $75k UDOT; $125k others

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Jon Bischoff	Structural Geotechnical Section/UDOT/Complex	965-4326	Yes
B) Hugh Boyle	Structural Design Group/UDOT/Complex	965-4517	Yes
C) Darin Sjoblom	Structural Geotechnical Section/UDOT/Complex	964-4474	Yes
D) Kyle Rollins	Civil & Environ. Engineering/BYU	422-6334	Yes
E) Travis Gerber	Civil & Environ. Engineering/BYU	422-1439	Yes
F) Marv Halling	Civil & Environ. Engineering/USU	435 797-3179	Yes
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Caltrans, NYDOT, Illinois DOT, Oregon DOT

Problem Title: Improvement of Deck Concrete Mix Design and Curing Practice **UTRAC No.** 05.08.-1

Submitted by: Paul J. Barr, USU

1. Briefly describe the problem to be addressed:

Bridge deck replacement is costly. UDOT has had a mixed experience in the performance of these bridge decks. According to Linford and Reaveley (2004) in 70 out of the 71 bridges that were investigated along I-15 had some type of cracking very within a few years after completion. However, some bridges decks built prior to the I-15 project have performed well with minimal problems. This research statement proposes to investigate deck cracking as a function of the mix design. It is believed by some that a reduction in the shrinkage of the concrete deck mix by as little as 20% would reduce the concrete bridge deck cracking significantly. However, in order to improve upon the existing practice, an investigation into the performance of the current concrete deck mix design needs obtained.

2. List the research objective(s) to be accomplished:

- Obtain shrinkage, tensile strength, freeze-thaw, chloride penetration and compressive strength of deck concrete from four representative bridges.
- Monitor the curing practices of four representative bridges.
- Develop an improved concrete deck mix design and curing specifications.

3. List the major tasks required to accomplish the research objective(s):

Phase 1

1. Meet with DOT representatives and pick representative bridges. (15 hours)
2. Perform a literature search on concrete deck mix designs from other states. (120 hours)
3. Obtain four concrete deck mix designs and test for shrinkage, tensile strength, freeze-thaw, chloride penetration and compressive strength. (1400 hours)
4. Observe the deck curing practices of four representative bridges. (80 hours)
5. Have interim meeting (perhaps after two or three bridges)to obtain DOT's input. (20 hours)
6. Interim report. This will include the concrete test results (baseline for future improvements), summary of curing practices and recommendations for possible future mix designs. (120 hours)

Phase 2

1. Develop mix designs with the goal of decreasing shrinkage while maintaining or increasing the freeze-thaw durability, tensile strength and chloride penetration (1300 hours)
2. Implement new mix design in the bridge of a newly constructed bridge (200 hours)
3. Monitor the behavior of the new concrete deck mix design (80 hours)

Phase 3

1) Write new bridge deck mix design specifications and meet with UDOT if necessary (60 hours).
2) Write new bridge deck curing specifications and meet with UDOT if necessary (60 hours)

4) Outline the proposed schedule (when do you need this done, and how we will get there):

Depending on the availability of the four concrete deck samples, Phase 1 of this project is intended to last one year. It is preferable that all the deck mixes be obtained over the summer as the material tests for each bridge will last up to six to eight months. The literature review as well as the interim meeting with UDOT can be done in series with the other research. For Phase 2, the development of the new concrete deck mix designs can also be done in 1 year. However in Phase 2 we will monitor the new bridge deck and the length of this will depend on how long UDOT wishes to observe the bridge deck. It is anticipated that the writing for Phase 3 can be done in 3 months time.

5. Indicate type of research and / or development project this is:

Research Project.

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?
University in conjunction with UDOT Staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- Improvements in UDOT's concrete deck curing specification and/or UDOT's concrete deck mix design specification.
- Concrete deck shrinkage, tensile strength, freeze-thaw, chloride penetration and compressive strength of the existing and proposed mix.
- Report documenting all research findings.

8. Describe how will this project be implemented at UDOT.
The final goal of this project is to improve the concrete deck mix and curing specifications for UDOT. This will involve a change in the specifications and possibly the curing practices. It is important that goal be obtained by understanding where we are at and then making an improvement. This problem statement addresses both the current state of practice of UDOT and improvements.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
Deck replacement is costly. This is made worse when a deck is cracked and major maintenance is required after only one or two years in service. Reducing the deck cracking and deterioration will save UDOTs scare money, allow this money to be used on other necessary projects and benefit all the users of the state.

10. **Describe the expected risks, obstacles, and strategies to overcome these:**
Deck cracking is a national problem. However, if the solution were simple if would have been obtained long ago. The problem is that it needs to be investigated on a regional level due to differences in materials, practices and environmental conditions. The strategy to improve this problem is to obtain the state of current practice, gather solutions from other DOTs, find a solution that will fit UDOT needs.

11. **List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):**

- Todd Jensen, Boyd Wheeler

12. **Estimate the cost of this research study including implementation effort (use person-hours from No. 3):**
Phase 1: $35,000
Phase 2: $30,000
Phase 3: $5,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:
Todd Jensen, Boyd Wheeler, David Eixenberger, John Butterfield

RESEARCH PROBLEM STATEMENT

Problem Title: Worker Visibility **No.: 05.01-3**

Submitted By: Darrell Giannonatti and Doug Anderson **E-mail:**

1. Briefly describe the problem to be addressed:

Safety in work zones is a high priority for UDOT. Construction projects are traditionally problem areas due to reduced number of lanes, narrow shoulders, increased congestion, construction vehicle movements, and other factors.

Determine if there is a benefit to utilize a different color for UDOT personnel to differentiate people resources from equipment and traffic control Devices. Investigate other DOT policies & procedures to determine innovative practices.

2. List the research objective(s) to be accomplished:

1. Review and identify national studies performed on subject.
2. Review and identify other state practices.
3. Idenfity best practice.
4. Create PPE policy for UDOT.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Determine National DOT standard practices.

2. Identify Scientific research performed on subject.

3. Research other state practices, policies and procedures as well as effectiveness.

4. Develop a best practices PPE policy.

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Contract by June, 2005.
The synthesis of research and Policy will be completed by October 31th, 2005.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consideration will be given to either consultant or University, depending upon credibility of staff and ability to complete by October 31st, 2005.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
A synthesis of research and an implementable policy.

8. Describe how will this project be implemented at UDOT.
Implement policy in construction.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
Increased Worker safety.

10. Describe the expected risks, obstacles, and strategies to overcome these.
None

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Darrell Giannonatti

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $25,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Resident Engineer (Ed Rock)			
B) Region Construction Engineers (Bob Westover)			
C) Region Traffic Engineer (Robert Miles)			
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Skid Index Trigger Values **No.:**05-02.6

Submitted By: Lloyd R. Neeley **E-mail:** lneeley@utah.gov

1. Briefly describe the problem to be addressed:

UDOT currently has in place a guideline for which values of skid index are considered standard, marginal, or deficient. UDOT practice is for Program Development to notify the Regions when skid index values for a section of pavement become deficient, and to advise them to program a corrective treatment, and to post the section as "Slippery When Wet" until such time that a corrective treatment can be applied. Logically, however, some values of skid index present more of a hazard than others. The intent of this problem statement is to develop performance curves for skid index that would help UDOT in programming preventive maintenance treatments.

2. List the research objective(s) to be accomplished:

1. Develop performance curves for skid index that can be used help program preventive maintenance treatments.
2. Produce a report that shows any relationships or trends for skid index on "families" of roadways.
3. Produce a report that explains the relationship between skid index and level of hazard in practical terms.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Review and summarize UDOT's original research used to establish the existing guideline.
2. Review and summarize measures used in other states to quantify skid resistance, reporting of those measures to interested parties, and trigger values for corrective action. Report on any differences between UDOT's measures and those used in other states.
3. Investigate and report on the relationship between UDOT's skid index and other material properties related to skidding such as the coefficient of friction.
4. Use UDOT accident data and skid data, to investigate statistical relationships between wet weather accidents and various values of skid index. Identify the most clear relationships, with emphasis on distinctions between levels of hazardous condition.
5. Develop performance curves for skid index and identify relationships between "families" of roadways and define how performance curves can be used in programming preventive maintenance treatments.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

5. Indicate type of research and / or development project this is:

Large: [X] Research Project [ ] Development Project

Small: [ ] Research Evaluation [ ] Experimental Feature [ ] New Product Evaluation [ ] Tech Transfer Initiative : [ ] Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, in combination with UDOT staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- Report describing the original research used to establish UDOT's current guideline and practice, describing other states' practices, and describing the meaning of the skid index in both theoretical and practical terms.
- Report describing the current research effort, including data used, analysis methodology, and results and conclusions.
- Performance curves for skid index that UDOT Regions and Districts can use in programming preventive maintenance treatments.

8. Describe how will this project be implemented at UDOT.

Based on the recommendations from the research, UDOT will establish a best practices manual for use by the Regions and Districts outlining the performance curves for skid index and how they may be used in programming preventive maintenance treatments.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will have a tool to use in planning and programming preventive maintenance treatments bases on expected skid index values.

Traveling public will also benefit from safer roadways.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Bill Lawrence

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Bill Lawrence	UDOT Program Development	965-4158	
A)	Lloyd Neeley	UDOT Central Maintenance	965-4789	Yes
B)	Gary Kuhl	UDOT Program Development	964-4552	
C)	Nathan Lee	UDOT Region 1	(801)620-1606	
D)	Doug Anderson	UDOT Research	965-4377	
E)	Russ Scovil	UDOT Program Development	965-4097	
F)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA, UDOT Traffic and Safety, UDOT Risk Management

RESEARCH PROBLEM STATEMENT

Problem Title: Asphalt Binder Uniformity — No.: 05.3-1

Submitted By: Cameron Petersen — E-mail: cameronpetersen@utah.gov

1. Briefly describe the problem to be addressed:

The hot-mix asphalt design is partly based on a known source and grade of PG Binder. If the delivered PG Binder's complex modulus and/or viscosity varies significantly, the mix volumetrics and dynamic modulus (E*) could be adversely affected. The affected E* will be critical when the designed pavement structure is based on an mechanistic design procedure partly based upon the characteristics of the proposed source and grade of the asphalt binder.

The Agency must know what the critical bounds are concerning delivered PG binder consistency and variation from the design binder.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Establish variation limits for delivered, discreet quantities of PG Binder to a paving project
2. Establish acceptable variation of delivered product from the mix-design binder
3. Address Mid-Range Temperature values as potential for use
4. Identify/quantify the sensitivity in performance to the variations in individual binder parameters
5. Identify appropriate measures of mix performance as they relate to binder properties

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Identify current binder grades and sources that are prevalent - Talk to Cameron
2. Work with refiners to define variabilities
3. Identify mixes that can be used to evaluate binder performance
4. Review statistical characteristics of binder parameter tests
5. Identify appropriate parameters for use in consistency control
6. Identify mix performance using the binders and define sensitivity

4. Outline the proposed schedule (when do you need this done, and how we will get there):

NEED FOR 2006-7 CONSTRUCTION SEASON. PG BINDER SAMPLES OBTAINED, MIX-DESIGNS PERFORMED, BINDER/MIX TESTS PERFORMED, DATA ANALYZED, AND REPORT DEVELOPED.

5. Indicate type of research and / or development project this is:

Large: X ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UNIVERSITY OF NEVADA-RENO

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

AN ASPHALT BINDER UNIFORMITY SPECIFICATION

8. Describe how will this project be implemented at UDOT.

MODIFICATION OF THE PG BINDER MANAGEMENT PLAN, CHANGES IN THE BINDER SPECIFICATION 02745 AND/OR ESTABISHMENT OF UNIFORMITY INCENTIVES

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UNIFORM PRODUCTS USED IN THE HMA AND PRODUCTS REFLECTING THE MIX DESIGN MATERIALS PRODUCE PAVEMENTS WITH REALISTIC PERFORMANCE EXPECTATIONS. UDOT'S RISKS BASED UPON ECONOMIC DECISIONS THAT ALLOW PAVEMENT THICKNESS REDUCTION BASED ON BINDERS HAVING EXPECTED RHEOLOGICAL PROPERTIES WOULD BE MINIMIZED. ULTIMATELY, THE TAX PAYER WOULD BE THE BIGGEST BENIFICIARY. THEY SHOULD EXPECT THE PAVING PROJECT TO FULLY PERFORM THROUGHOUT ITS DESIGN LIFE..CONTRACTORS WOULD BENIFICT BY USING CONSISTENT PRODUCTS.

10. Describe the expected risks, obstacles, and strategies to overcome these.

EXPECTED BINDER PRODUCTION COSTS ARE POSSIBLE DURING A SUPPLIERS LEARNING CURVE DEVELOPMENT AND MODICIATIONS TO QUALITY CONTROL PROCEDURES.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): KEVIN VANFRANK

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $90,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Kevin VanFrank	UDOT Materials Division, Materials Research Engineer	965-4426	Yes
B) Tim Biel	UDOT Materials Division, Engineer For Materials	965-4859	Yes
C) Cameron Petersen	UDOT Materials Division, Asphalt Engineer	965-4296	No
D) Steve Niederhauser	UDOT Materials Division, Mts Engr. Assist.	965-4293	No
E) Rod Terry	UDOT Region One Materials Engineer	791-5305	Yes
F) Jim Cox	UDOT Region Three Materials Engineer	227-8035	Yes
G) Mohommad Rahman	Granite Construction	526-6130	Yes
H) Stephane Charmot	Koch Asphalt Products	673-6579	No

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: TRB/AASHTO BINDER AND MIX EXPERT TASK GROUPS

ROCKY MOUNTAIN ASPHALT USER/PRODUCER GROUP

RESEARCH PROBLEM STATEMENT

Problem Title: Bridge Scour Countermeasure Phase II No.: 05.04-2

Submitted By: Michael Fazio E-mail: mfazio@utah.gov

1. Briefly describe the problem to be addressed:

Sister and Regulatory agencies have placed an increased emphasis on the "soft armoring" and modified rock vanes & barbs to provide natural stream stability enhancement measures instead of traditional engineering responses to stabilize river and stream beds against scour. These measures include the construction of shallow flow control structures, referred to as Rosgen countermeasures, across all or part of the river. Structure types include cross vanes and j-hooks. Claims have been made that these structures are durable, cost effective, and provide scour stability, but the necessary case studies have not been documented to verify these claims.

2. List the research objective(s) to be accomplished:

1. In depth examination and monitoring of a recently constructed installation
2. Determining the applicability of numerical modeling approaches to evaluate these types of structures
3. Define conditions for which these non-traditional engineering approaches can be applied

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Continue to monitor the performance of the selected in-stream structures
2. Survey and model additional structures at different locations
3. Model flow though the structures
4. Compile empirical equations for designing structures for defined flow rates
5. Prepare a manual for designing the type of structures near highway facilities

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project should be completed in two years. Complete the monitoring of the existing structures in one year, complete the modeling in the following 6 months and prepare the manual for the remainder of time

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Manual for designing the shallow flow structures in water courses near highway facilities.

8. Describe how this project will be implemented at UDOT.

The results of the research will aid the designers to improve water course crossing, mitigating the impact of long term erosion and scour on highway elements.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT and the public in general will benefit from the installation of more natural structure in the river environments next to highway structures. These structures when properly designed can provide long lasting protection for highway facilities and better habitat for aquatic fauna.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Lack of flow in the rivers where we are studying the installations. Two-dimensional modeling or scale modeling may help overcome this problem.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Michael Fazio, Denis Stuhff, Tim Ularich

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $42,000 (plus some BYU contributions)

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Dr. Zundel	Brigham Young University	801-422-4080	√
B) Dr. Miller	Brigham Young University		√
C) Brent Jensen	UDOT		√
D) Terry Johnson	UDOT		√
E) Lars Anderson	UDOT		√
F) Kevin VanFrank	UDOT		
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

US Forest service, FHWA, other DOT's across the country, Consultants, US Corp of Engineers, Regulatory Agencies

RESEARCH PROBLEM STATEMENT

Problem Title: Access Management Performance Index **No.:**05.05-3

Submitted By: Tim Boschert (UDOT), Grant Schultz (BYU)

E-mail: tboschert@utah.gov
gschultz@byu.edu

1. Briefly describe the problem to be addressed:

The purpose of this project is to develop a performance index to target facilities that would receive the greatest benefit from the implementation of access management principles. This would be accomplished by collecting existing data by facility type and determining the impact that access management techniques have had on safety and economics at these locations. With the data collected, a performance index would be established to target facilities by volume, crash rate, speed, signal spacing, and other factors in an effort to determine the best use of access management principles and applications. The resulting performance index could then be tied to the LRP, TIP, and STIP to target and prioritize areas for access management implementation.

UDOT and their Consultants have updated the Administrative Rule relating to access management and the subsequent access management program that aims to provide guidance to Department personnel in maintaining and preserving both existing and future capacity on the state roadway network. The success of access management programs has been at the forefront of state DOTs across the nation. The Utah Rule, R930-6, relating to access management, provides guidance for design, operations, and project managers to better implement access management techniques in both existing and future projects. It is critical that the state of Utah be at the forefront in developing long-term preservation of businesses, access, and safety of the traveling public.

Strategic Goal: ☒ Preservation ☒ Operation ☒ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Development of a performance index to help prioritize access management projects statewide.
2. Utilization of the GIS enabled web delivered data almanac to aid in identifying target locations.
3. Target roadways that would benefit from access management implementations based on the performance index results.

3. List the major tasks required to accomplish the research objective(s): 1 year Estimated person-hours 1,600

1. Literature review to establish the state of the practice on access management performance index evaluation.
2. Identify facilities where access management principles have been implemented as well as facilities where they have not.
3. Utilize the GIS enabled web delivered data almanac to summarize crash and AADT data at target locations.
4. Develop a performance index based on the results of the data collected.
5. Provide recommendations on future access management implementation statewide.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

It is recommended that this project begin in late Fall 2005, early Winter 2006 with the literature review and data collection.

Develop relationships between data collection sites and develop performance index during the Summer 2006.

Provide recommendations for access management installation at the end of the Summer, beginning of Fall 2006.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative:
☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff joint participation.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables expected from this project would include: 1) an evaluation of access management projects statewide, 2) development of a set performance standards from the access management sites, 3) implementation of access management performance indices in the UDOT Design Manual, and 4) application of the performance index for future planning projects.

8. Describe how this project will be implemented at UDOT.

This project will be implemented at UDOT jointly through the access management and planning programs. The results of the study will be very useful in aiding in the process to target facilities that would receive the most benefit from the implementation of various access management initiatives.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit in all divisions through a new process to better identify locations and corridor segments where access preservation and safety can be improved through access management treatments.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Tim Boschert, Access Management/Program Coordinator, (801) 965-4175

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Grant Schultz	Brigham Young University	(801) 422-6332	
B) Glen Ames	UDOT Planning	(801) 965-4953	
C) Chris Glazier	UDOT ISS	(801) 965-4381	
D) Rob Clayton	UDOT Safety Programs Engineer	(801) 964-4521	
E) Doug Anderson	UDOT Research Project Manager	(801) 965-4377	
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: TRB Access Management Committee, NCHRP

RESEARCH PROBLEM STATEMENT

Problem Title: Traffic Analysis Training (Permitting, Safety, Design) **No.: 05.06-7**

Submitted By: Tim Boschert (UDOT) / Grant Schultz (BYU) **E-mail:** tboschert@utah.gov gschultz@byu.edu

1. Briefly describe the problem to be addressed:

The purpose of this project is to develop a training process to supplement and aid in the effective implementation of a unified statewide traffic analysis process. Training would be established and taken from Region to Region to train affected personnel and groups on the benefits and process of performing and analyzing traffic studies. In conjunction with the development of the training process, all end users would be invited to suggest input to the process and training guide. Internal training would be developed first and secondly educate end users of the process and tools. The training would serve UDOT staff, consultants and those interested in design issues.

Traffic analysis study is an integral part in the development of identification and design toward safe and efficient systems.

UDOT and their Consultants have updated the Administrative Rule relating to Access Management and the subsequent access management program that aims to provide guidance to Department personnel in maintaining and preserving both existing and future capacity on the state roadway network. The success of access management programs has been at the forefront of state DOTs across the nation. The Utah Administrative Rule, R930-6, relating to access management has been in circulation throughout the Department since 2003. This rule provides guidance for design, operations, and project managers to better implement access management techniques in both existing and future projects. The sooner that the Department is consistent in its use and application, the sooner the Department will succeed in addressing the safety and capacity of the transportation network. It is critical that the state of Utah be at the forefront in developing long-term preservation of businesses, access, and safety of the traveling public. Traffic analysis study is an integral part in the development of identification and design toward safe and efficient systems.

Strategic Goal: ☒ **Preservation** ☒ **Operation** ☒ **Capacity** ☒ **Safety** (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Development of a training analysis process to help users and customers understand the process of traffic analysis role and benefits.
2. Train Region personnel and external users on the proper use of the TIA guidelines and the importance of TIA's in this process.
3. Provide additional guidance to Region Traffic Engineers, Permits Officers, PM's, Designers and Consultants to ensure consistency statewide.

3. List the major tasks required to accomplish the research objective(s): 1 year Estimated person-hours 1,600

1. Literature review and focus groups to establish the state of the practice on traffic impact analysis training, evaluation, implementation.
2. Identify key concepts from the access management process to form the basis of the training program.
3. Develop training materials for both TIA guidelines and process and analysis of the studies.
4. Provide a canned stand alone training tool and establish a regular rotation for future training statewide.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

It is recommended that this project begin in late Fall 2005, early Winter 2006 with the development of the training process.

A draft training module would be unveiled by late Spring 2006 and the training program established for the Summer 2006.

Training would be undertaken during the summer months with feedback provided and recommendations made on future training.

5. Indicate type of research and / or development project this is:

Large: ☐ **Research Project** ☐ **Development Project**
Small: ☐ **Research Evaluation** ☐ **Experimental Feature** ☐ **New Product Evaluation** ☒ **Tech Transfer Initiative**:
☐ **Other**_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff joint participation. Input from focus groups from the end users; UDOT and consultants.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables expected from this project would include: 1) a process and manual for performing and analyzing TIA s, 2) a set policy for training to ensure appropriate users receive training, 3) implementation of a training process to be included in the UDOT Design Manual, and 4) establishment of a rotational process to update training and ensure consistent coverage statewide.

8. Describe how this project will be implemented at UDOT.

This project will be implemented at UDOT jointly through the Project Development and traffic & safety programs. The result of this development will be extremely useful in ensuring that Department personnel from all divisions understand the importance of a uniform analysis process and how they can benefit from the program and aid the Department in providing a safe and more efficient transportation system. Out reach and education will be necessary across several UDOT divisions. Planning, Project Development, Traffic and Safety, and Right of Way (permitting).

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit in all divisions through a unified understanding and process of traffic impact analysis, its role, and the benefits it can provide. Expected will be increased efficiency of performance and analysis resulting from a standardized format. Consultant firms will benefit through the standardization.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Tim Boschert, Access Management/Program Coordinator, (801) 965-4175

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):$30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Grant Schultz	Brigham Young University	(801) 422-6332	
B) Darin Duersch	UDOT Region 1 Traffic Engineer	(801) 620-1607	
C) Ritchie Taylor	UDOT Region 2 Traffic Engineer	(801) 887-3717	
D) Doug Bassett	UDOT Region 3 Traffic Engineer	(801) 227-8019	
E) Troy Torgersen	UDOT Region 4 Traffic Engineer	(435) 893-4707	
F) Statewide Permit Officer	UDOT Project Development	(801) 964-4528	
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

TRB Access Management Committee, NCHRP, Consultant firms, ITE

RESEARCH PROBLEM STATEMENT

Problem Title: Programming of Strong Ground Motion Instrumentation of New Bridges

No.: 05.07-2 (also 05.08-2)

Submitted By: Marv Halling, USU

E-mail: halling@cc.usu.edu

1. Briefly describe the problem to be addressed:

As new bridges are being constructed, the need for faster construction, more economical designs, and longer lasting infrastructure is becoming more and more important. These issues are paramount at the national level with FHWA Initiatives such as the "Bridge of the Future" and "Smart Structures." In order to improve the performance of modern structures, instrumentation and monitoring of representative structures is necessary. This problem statement addresses the need to install and maintain strong motion (earthquake) instrumentation as well as additional instrumentation.

2. List the research objective(s) to be accomplished:

1. To plan, design, and install long term monitoring instrumentation in representative structures during construction.

2. To place sensors in bridge and foundation systems that will be useful in detecting degradation of the structural component.

3. To establish procedures where bridges are selected and designated for various types of instrumentation.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Study the recommendations of FHWA, and take a survey of the approaches of other state DOTs.

2. Establish criteria for the selection of instrumentation and bridges to be instrumented.

3. Design of the instrumentation packages for one or two selected bridges on Legacy Highway.

4.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

This project is anticipated to have a duration of approximately 1 year. The duration of one year is noted to allow for the flexible Legacy Highway schedule.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverable would be a set a guidelines regarding instrumentation of UDOT structures. Recommended prioritization of proposed instrumentation locations. Develop standard drawings, specifications and details for installation of instrumentation. Estimated cost per array.

8. Describe how will this project be implemented at UDOT.

It is anticipated that the initial project will be funded by the research division, with guidelines for long term future funding coming from construction funds for new construction and from repair funds.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The beneficiaries at UDOT will be the engineers charged with observation and maintenance of UDOT bridges.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The main obstacle will be funding the longer term program. With interest in improved performance requirements for new construction, the monitoring of bridges will become a necessary construction cost. These expenses will be extremely small compared to construction budgets.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Jim Higbee, UDOT

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $ 30,000.

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A Todd Jensen, UDOT			
B) Jon Bischoff, UDOT			
C) Boyd Wheeler, UDOT			
D) Paul Barr, USU			
E) Keri Ryan, USU			
F) Steve Bartlett, UU			
G) Jim Bay, USU			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

UU Seismic Stations, USGS, UGS, ANSS Program, FHWA

RESEARCH PROBLEM STATEMENT

Problem Title:	Design and Development of a Context Sensitive Visual Resource Assessment and Management (VRAM) System for UDOT	No.: 05.04-1
Submitted By:	John C. Ellsworth, Lars Anderson, Terry Johnson	E-mail: terryjohnson@utah.gov

1. Briefly describe the problem to be addressed:

Quantifying visual impacts for new highway projects is an environmental document requirement. Several states are beginning to use VRAMs as an environmental evaluation tool for these visual resources and they could be compared to other methods that we routinely use such as: the TNM model for noise analysis and CO Hot Spot Analysis for air quality analysis.

UDOT would benefit from a VRAM system designed to work within the great diversity of landscapes through which our state's highways pass. Various federal agencies have separate and conflicting visual resource analysis and management systems therefore, UDOT needs a system that works with the various agency systems. The UDOT VRAM will be closely tied to the FHWA visual impact analysis procedures.

Strategic Goal: ☒ Preservation ☐ Operation ☒ Capacity ☐ Safety (Check all that apply)

VRAM implementation would preserve the visual resources of our existing roadsides. It's also a key for new capacity approvals since projects such as adding lanes in canyons or urban roadway capacity require visual resource impact analysis and mitigation. VRAM implementation would accomplish these visual resource tasks associated with projects more confidently and rapidly.

2. List the research objective(s) to be accomplished:

1. Design a feasible and practical VRAM system for UDOT.
2. Design appropriate strategies to effectively interface UDOT VRAM with USFS, BLM, NRCS, et al VRAM systems, thereby facilitating and streamlining federal agency approvals of UDOT projects.
3. Develop a workbook approach to UDOT VRAM system implementation.
4. Develop a modular organization for applying the new system to UDOT highway projects in various landscapes in a context sensitive fashion.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Research the visual resource analysis and management need in UDOT. (200 hrs)
2. Conduct appropriate literature and case study review. (200 hrs)
3. Compare various federal and state agencies VRAM systems including other state DOT's, and identify critical components for interface linking with the new UDOT VRAM system. (500 hrs)
4. Using the FHWA system as the umbrella, incorporate findings of 1-3 above in the design of a new UDOT VRAM system. (800 hrs)
5. Review and discuss with UDOT stakeholders at each step in the system design process. (100 hrs)
6. Utilize rapid prototyping approach to UDOT VRAM system development (design pilot system; test system on one or two UDOT projects; analyze results; initiate revisions; retest and finalize system). (400 hrs)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

We could use the end product today, but realistically would like to see it done within one year.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University or Consultant who has experience with VRAMs

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A VRAM procedural (how to) manual that is acceptable to the various agencies and UDOT, which has been field-tested on a couple of UDOT projects and revised based upon the outcome of the tests.

8. Describe how will this project be implemented at UDOT.

Once the manual is completed and approved, UDOT will need to incorporate VRAM into their environmental process. Consultants and UDOT environmental staff will need to be brought up to speed on the new process.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Currently UDOT does not have a process in place to evaluate visual resources. This project would develop a VRAM process for UDOT to be used by landscape architects, environmental staff and consultants.

Improve response to the requirement in EAs and EISs for Visual Resource Assessments while improving relations with Federal Agencies.

Improved management of the scenic resources of the state along UDOT highways.

Improved public relations through better management of scenic resource impacts associated with UDOT projects.

Decreased project review, analysis, and public hearing costs resulting from the implementation and use of a rational and defensible system for managing scenic resources and impacts associated with UDOT projects.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Developing a VRAM process that is suitable to all agencies involved. - Early coordination with all agencies and keeping them involved in the process should alleviate the problem.

Visual analysis/management is new to UDOT so changing the way we do business could be an obstacle. – Developing an easy process to follow and being properly trained will alleviate these issues.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Lars Anderson and Terry Johnson

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): 2200 hrs. X $40 = $88,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
John C. Ellsworth	Utah State University		
David Hatch	U S Forest Service	524-3949	
Greg Punske	FHWA	963-0078	
Chris Hartman	U S Forest Service		
Rob Sweeten	BLM, Moab		
Brandon Weston	UDOT Reg. 3	277-8089	

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

a. Division of Wildlife Resources http://www.wildlife.utah.gov/ (reason being that wildlife viewing is often considered an aesthetic experience and is often done from a moving vehicle);
b. Envision Utah http://www.envisionutah.org (reason being they are concerned with many aspects of transportation planning, growth, etc. and visual/scenic resources are part of that planning);
c. Automated Geographic Reference Center http://agrc.its.state.ut.us/ (reason being there would likely be a GIS component to this research and they are at the forefront of state agencies in this regard);
d. Utah Travel Council http://www.utah.com/ (reason being they support and promote tourism in Utah including along state highways and scenery is a major marketing factor);
e. Utah Department of Community and Economic Development http://dced.utah.gov/community/community.html (reason being they support downtown appearance and economic development in Utah cities and towns and UDOT highways often traverse these communities and in many are the Main Street in those communities);
f. Utah Historical Society http://history.utah.gov/ (reason being they support historic presevation and various history programs, and UDOT highways often traverse historic landscapes and pass within viewsheds of historic sites, and the UDOT VRAM would address these "historical context sensitive" sites and landscapes);
g. Utah Division of Travel Development http://travel.utah.gov/ (reason being they support Scenic Byways and highways, indeed they publish a "Utah! Scenic Calendar" which highlights 16 of Utah's 28 Scenic Byways);
h. Utah Department of Environmental Quality http://www.eq.state.ut.us/ (reason being that visual/scenic resources are a major part of the quality of the Utah environment);
i. Utah Division of Forestry, Fire, and State Lands http://www.ffsl.utah.gov/ (reason being the state forest lands are a major source of visual/scenic quality and also these lands are often adjacent to National Forest and BLM lands where visual resource management is required);
j. Department of Natural Resources http://www.nr.utah.gov/ (reason being they manage for outdoor recreation and visual/scenic resources are a major factor in that);
k. Division of Oil, Gas, and Mining http://ogm.utah.gov/ (reason being oil and gas and mining often occurs on federal lands or state lands which are highly visible from UDOT highways and surface mines and oil and gas fields are highly controversial in terms of visual/scenic impacts);
l. Division of Parks and Recreation http://www.stateparks.utah.gov/ (reason being they manage state parks and visual/scenic issues are very important to users of the state Parks);

Robert Draper, FHWA Planner & Director of National Scenic Byways Program, Washington D.C.

Ramiro Villalvazo, US Forest Service Chief Landscape Architect, Washington D.C.

Robert Snieckus, NRCS, Chief Landscape Architect, Washington, D.C.

Brad Cownover, BLM Chief Landscape Architect, Washington, D.C.

Blaise Grden, Army corps of Engineers Planner, Walla Walla, Washington

RESEARCH PROBLEM STATEMENT

Problem Title: Targeted and Adaptive Simulator Training for Winter Maintenance No.: 05.02-07

Submitted By: David Strayer, University of Utah E-mail: David.Strayer@utah.edu

1. Briefly describe the problem to be addressed:

The proposed project is an extension of an earlier UDOT research project developing and evaluating advanced simulator training for UDOT winter maintenance operators. In a pilot study, ratings of the training effectiveness were very high; the odds of getting in an accident were lower, and fuel efficiency was higher for trained drivers than for a matched control group. Plans now call for training ¼ of the maintenance operators each year over the next four years. The current research proposal is to develop an assessment procedure for targeting those drivers who will benefit most from training and provide an adaptive training procedure that customizes the simulator training to suit the specific needs of each driver. The assessment procedures may determine that some drivers are proficient at all the requisite skills and require little if any training, whereas other drivers may require considerabe training in specific problem areas. In addition, we plan to evaluate the effectiveness of the training by tracking performance of the trained drivers and use this information to further refine and customize the simulator training to maximize the cost effectiveness for UDOT.

Strategic Goal: Operations, Safety

2. List the research objective(s) to be accomplished:

1. Develop assessment procedures to target specific drivers for training
2. Develop methods for customizing the simulator training to the specific needs of each driver
3. Evaluate the effectiveness of training for those drivers who receive training and use this information to refine training protocols

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Identify criteria for assessment procedures
2. Develop, validate, and administer assessment procedure on selected drivers
3. Identify targeted drivers who will benefit the most from training
4. Develop pre-training high-fidelity simulator screening protocol to identify specific strengths and weaknesses of drivers
5. Develop post-training high-fidelity simulator screening to determine effectiveness of training
6. Develop procedures and incentives for drivers to keep accurate records of fuel and vehicle usage
7. Collect and evaluate on-road driving performance measures (e.g., accidents, fuel usage, etc.)
8. Produce final technical report

4. Outline the proposed schedule (when do you need this done, and how we will get there):

There will be two major components to the project. The first is to develop methods for assessing the skill set of drivers, identifying those who are likely to benefit most from the simulator training and customizing the training to suite their needs. These procedures should be in place at the end of the first year of the project. The second component of the project will be to evaluate the effectiveness of training by tracking the performance of drivers over a two years period (two training cohorts compared to matched drivers who have not undergone training). Assessment should be completed and technical report submitted by the end of the second year of the project.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University of Utah

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Deliverables will include a method for targeting the drivers who will benefit the most from training, a method for customizing the training to meet the specific needs of the drivers, and a technical report describing the effectiveness of training.

8. Describe how will this project be implemented at UDOT.

Facilities for the research project will be at the University of Utah and at L3 Communications. The procedures will be integrated into the ongoing advanced simulator training by identifying the drivers who will benefit most from training.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit by improving the safety (and fuel efficiency) of winter maintenance operations. The procedures for targeting drivers who will benefit most from training and methods to adaptively customize the training will increase the cost effectiveness of the training for UDOT. The pilot study suggests that training will result in a significant reduction in accidents and an increase in fuel efficiency.

10. Describe the expected risks, obstacles, and strategies to overcome these.
To evaluate changes in performance following training, it is necessary that records of accidents, incidents, and other safety information be collected for the drivers who are targeted for training and for a comparison group who does not receive training. We will also need to obtain accurate fuel consumption records (i.e., MPG) for each vehicle/driver. Records of accident data in the pilot study were adequate, however better data monitoring is needed for fuel records. We will need to develop procedures for drivers to keep accurate fuel logs and to monitor which vehicles were used.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Richard Clarke, Shana Lindesy

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $69,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) David Strayer	University of Utah	581-5037	Y
B) Frank Drews	University of Utah	585-1977	Y
C) Ira Bickford	UDOT	965-4119	Y
D) Jeff Hulse	UDOT	965-4510	N
E) Todd Richins	UDOT	975-4964	N
F) Dennis Blessinger	L3 Communications	303-5641	N
G) Paul McKee	L3 Communications	994-2138	N

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: AZ-DOT

RESEARCH PROBLEM STATEMENT

Problem Title: Determination of Crash Costs for Use in Benefit/Cost Analysis **No.: 05.05.11**

Submitted By: Jim McMinimee and Doug Anderson **E-mail:**

1. Briefly describe the problem to be addressed:

The available information that is used to estimate benefit/cost for transportation related improvements should be reviewed. Very high estimates of crash costs have been used in the past. This appears to be a case where societal estimates are being used for analytical purposes. Current value used by UDOT is 3.1 Million.

Benefit/cost estimates for pavement management, bridge replacements, intersection analysis, safety, traffic congestion mitigation, and other transportation improvements need to be appropriate and comparable.

2. List the research objective(s) to be accomplished:

1. Review national studies performed on the subject. Health industry, life insurance industries, etc.
2. Identify other states practices.
3. Make recommendations with regards to the value for one human life in other industries
4. Create policy that can be sued by each of the areas listed above

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Literature search, industry search
2. Create list of all the values used and how these values were determined
3. Summarize the research
4. Assemble a TAC that makes decision on what value to use and determine how this value will affect cost/benefit estimates, asset management, brides, etc.
5. Make Recommendations

4. Outline the proposed schedule (when do you need this done, and how we will get there):

One Year or ASAP
Literature Search has been done

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
A report documenting recommended values. The report will recommend policy for use UDOT Policies.

8. Describe how will this project be implemented at UDOT.
Ues their value to implement cost/benefit Analysis and establish a State Policy

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT has already been mandated to prioritize projects, and UDOT need a value that can be used

10. Describe the expected risks, obstacles, and strategies to overcome these.

Current Policy

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Jim McMinimee

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Paul Vidmar			
B) Jim McMinimee			
C) Doug Anderson			
D) Research			
E) Risk Management/Loss Control			
F) Traffic and Safety			
G) FHWA			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

UDOT

RESEARCH PROBLEM STATEMENT

Problem Title: Update the original "Good Roads Cost Less" Study to evaluate recommended performance measures and goals

No.: 05.05-10
(Was 05.03-2)

Submitted By: Gary Kuhl

E-mail:

1. Briefly describe the problem to be addressed:

The original study published in 1977 used an economic analysis to recommend the condition level that should be attained for the highway system in order optimize the benefits and costs. Various pavement rehabilitation strategies were considered through examination of different levels of acceptable performance and their associated benefits and costs. These benefits and costs were reduced to an annual basis considering the life cycle costs for each strategy. Special consideration was given to the benefits and costs to motorists as well as the State and the potential effect on energy consumption was determined. A cost estimate to upgrade the State highway system to the levels defined by the strategies was developed.

Evaluate current User Costs, Pavement Life, Pavement Treatment Life, and recommend appropriate Pavement goal(s) and measures to optimize funding and maximize pavement performance & user benefits.

2. List the research objective(s) to be accomplished:

1. Identify Pavement Performance Goal and Measures.
2. Identify optimum system condition & funding stream required to meet goals.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Review and complete update of 1977 & 2000 research effort using current costs and dTims pavement performance model.
2. Conduct a literature search to determine how other states are managing their pavement systems.
3. Evaluate Utah's highway system and recommend a set of target pavement condition levels that is appropriate.
4. Determine pavement rehabilitation and maintenance strategies to extend the life of Utah's pavements, and optimize the life-cycle cost of the system using dTIMS program output..
5. Estimate the cost of each rehabilitation and maintenance program needed to meet the system goals using dTIMS. .
6. Develop a short and long-range plan, including all tasks, costs, and schedules required to meet the pavement management targets.
7. Publish all information in a final report.
8. Implement in Pavement Management Program and Pavement Design Manual.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin ASAP and complete in 6 months.

5. Indicate type of research and / or development project this is:

Large: Research Project ☐ Development Project
Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant and UDOT staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A final report is needed that would contain a complete pavement management plan.

- Recommended performance measures and goals
- Revisions and modifications to Pavement and Design Manuals

8. Describe how will this project be implemented at UDOT.

Funding for the program will be requested. Changes will be made to dTims program, department measures and goals for pavement. The new goals will guide the budget levels needed to achieve or maintain.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Utah's pavements will last longer and provide a safer transportation network at the optimal condition and cost.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Political Influence. Must explain the optimization strategy to legislature, public.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Kim Schvaneveldt , Asset Management Director

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Gary Kuhl	UDOT Pavement Management		Yes
B) Doyt Bolling	Utah Technology Transfer		Yes
C) Doug Anderson	UDOT Research		Yes
D) Chris Glazier	UDOT ISS		Yes
E) Jeff Zavitski	Deighton Associates, LTD (consultant)		No
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: SMA Paving Mechanistic Properties — No.: 05.3-3

Submitted By: Rodney Terry — E-mail: rodterry@utah.gov

1. Briefly describe the problem to be addressed:

With the growing use of Stone Matrix Asphalt pavement (SMA) it's mechanistic design properties: resilient modulus, dynamic modulus, flexural strength and cold weather cracking susceptibility, need to be known to full benefit of its contribution to the paving system.

The information to be gathered/evaluated would be resilient modulus and dynamic modulus of SMA mixes used in Utah. Additional test to be run on selected mixes to get the cold weather and fatigue and other information Ie. Bending beam TSRT etc. These tests could be run at UNR or other Superpave center throughout the country.

Strategic Goal: X Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Learn the true mechanistic properties of SMA used in Utah and validate design assumptions.

2. Develop the Structural Number to be used for SMA layers in pavement designs using the current AASHTO design method.

3. Develop inputs for the SMA layer to be input into the mechanistic design process.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Develop a testing strategy and data collection process for Dynamic Modulus data using the Simple Performance Testers that are to be in place at each Region, and non-DOT testing devices for calibration and correlation. – Will require definition of a SPT FOP.
2. Evaluate data from modulus testing to determine default values for pavement design guides.
3. Develop testing strategy and implement testing strategy to develop cold weather and fatigue data.
4. Evaluate data from testing and develop appropriate design guide input and department guidelines.
5. Populate Materials Library for the ME Design Process
6. Crunch designs to validate inputs.
7. Evaluate previous placements from 2004
8. Review alternative procedures for evaluating existing pavement sections that are thinner than requirements.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Would like to see this begin during (2005) construction season, with delivery of SPTs in Regions, and last over two seasons to gather a sufficient amount of data with interim reports annually and a final report at conclusion

5. Indicate type of research and / or development project this is:

Large: X Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant-University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Interim reports to indicate current experience and best to date design assumptions for modulus and other design inputs.
2. Final report to summarize data and provide guidelines for SMA design and use.
3. Materials Library data values
4. SPT FOP

8. Describe how will this project be implemented at UDOT.

The design parameters for SMA would be included in department pavement design guide.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Better understanding of the SMA design parameters will allow the pavement designer to optimize the use of SMA in pavement design and realize cost savings in the overall pavement system.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Rodney Terry, Region 1 Materials Engineer, 801-399-0354

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $100,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Tim Biel	UDOT Central Materials	965-4859	y
B) Kevin VanFrank	UDOT Central Materials	965-????	Y
C) Steve Niederhauser	UDOT Central Materials	965-4293	
D) Mohommad Rahman	Granite Construction	526-6130	y
E) Doug Watson	CMT EngineeringLaboratories	936-1567	
F) Larry Gay	UDOT Region 4 Materials	435-896-1306	y
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Use of geologic and geophysical (SASW) methods to prioritize mitigation options for SR-9 in the Coal Hill landslide area, Region 4 **No.: 05.07-6**

Submitted By: Geologic Hazards Program, Utah Geological Survey
Dept. of Civil & Environmental Engineering, Utah State University
E-mail: francisashland@utah.gov

1. Briefly describe the problem to be addressed:

Continuing road damage along a wide section of SR-9 where it crosses the Coal Hill landslide area poses a hazard to the traveling public accessing Zion National Park from the east and an ongoing expense for R-4 to repair and maintain the roadway, embankments, and culverts in the affected area. Based on the size (width) of the landslide, global stabilization appears unfeasible and geotechnical subsurface investigation costly. Recent UGS mapping shows localization of historical movement, suggesting that detailed mapping of the landslide and displacement measurements may allow for zonation of the slide based on relative hazard. Such zonation may provide the basis for more cost effective geotechnical subsurface investigation and stabilization/relocation feasibility assessment. In addition, we propose to test the application of Spectral Analysis of Surface Waves (SASW) geophysical measurements to define the soil/rock profile and depth of the rupture surface in the landslide. The SASW method is not limited by a velocity inversion, allowing for the possible identification of a low velocity (clay) layer below rock or landslide debris.

2. List the research objective(s) to be accomplished:

1. Define boundaries in the landslide area that can be used as a basis of landslide zonation.
2. Map relative displacements of defined parts of the landslide area, identify active and inactive parts of slide area, and correlate with road damage as a basis for zonation mapping.
3. Constrain subsurface landslide geometry based on detailed mapping and shear-wave velocity profiles to define range in probable borehole depths in future geotechnical subsurface investigations.
4. Test the application of SASW measurements in defining the soil/rock profile and depth to the rupture surface in a landslide.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Map internal landslide deformation features (1:2400 scale) using aerial photographs and field techniques: 104 hours
2. Measure landslide displacement over a year period using precise GPS surveying equipment, deploying benchmarks in all mapped internal blocks of the slide; data analysis: 296 hours
3. Inventory road damage and distress, measuring displacement of historical features (SR-9 and past roads): 8 hours
4. Conduct three or four SASW measurements to define soil/rock profile in the landslide and depth to rupture surface (clay zone): 104 hours (96 hours USU, 8 hours UGS)
5. Create geologic cross sections of the landslide using detailed mapping, preliminary slope-stability analysis results, and shear-wave-velocity profiles from SASW measurements (including data analysis); write report: 420 hours (264 hours USU, 156 hours UGS)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Anticipated study period: August 1 to July 31.
August: Aerial photograph mapping, review of geologic and engineering literature on landslide.
September: Detailed geologic mapping, road distress inventory, GPS benchmark deployment and initial baseline measurement.
September-October: SASW measurements (fall option)
October-June: GPS landslide movement monitoring and displacement mapping
March-May: SASW measurements (spring option)
May-June: Landslide hazard zonation mapping
June-July: Prepare maps, geologic cross sections, shear-wave-velocity profiles, and report

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Utah Geological Survey, Geologic Hazards Program (geologic studies)
Department of Civil & Environmental Engineering, Utah State University (SASW measurements)

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Deliverables include a detailed zonation map defining highest hazard area of SR-9 across the landslide area. A report will provide the annual displacements, average rate of movement, and movement duration in each zone, geologic cross sections and shear-wave velocity profiles constraining the probable depth of the rupture surface(s). Recommendation of future uses of technology for UDOT landslide assessments.

8. Describe how will this project be implemented at UDOT.

Results will be used to assess cost-effective approaches for further geotechnical subsurface investigations and the feasibility of stabilization/relocation options.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The zonation map will provide Region 4 engineers with a tool for assessing the feasibility of stabilizing the highest hazard sections of SR-9 by defining the length of road in each hazard category and/or mitigation alternatives such as highway relocation. The map and other deliverables will provide a basis for more accurate geotechnical subsurface investigation cost estimates.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Vegetation and surficial soil conditions may limit to some extent the ability to map internal landslide deformation features. Preliminary review of aerial photographs suggests detailed mapping of these features is feasible. Landslide movement has been regularly recurrent, but a dry period may limit our ability to measure displacements on the slide. Currently wetter than normal precipitation in much of southern Utah suggests favorable conditions for measuring landslide movement. High velocity rock layers that present a large impedance contrast and thin clay zones along the rupture surface pose an unknown challenge to successful SASW profiling of the clay zones. The SASW method is not limited by the velocity inversion problem, however.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Leslie Heppler (Geotechnical Division)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $19,500 (UTRAC amount); plus $9,150 (UGS cost share) and $2,850 (USU cost share) – approx 60/40 cost share.

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Gary Christenson	Utah Geological Survey	537-3304	
B) Loren Anderson	Department of Civil & Environmental Engineering, Utah State University	(435)797-2938	Yes
C) Dal Hawks	Utah Department of Transportation, Region Director R-4	(435)893-4700	
D) Robert Dowell	Utah Department of Transportation, Richfield District Engineer	(435) 896-1300	
E) Rick Torgerson	Utah Department of Transportation, Project Manager R-4	(435)893-4781	
F) Grant Gummow	Utah Department of Transportation, Geotechnical Division	965-4307	
G) Daniel Horns	Utah Valley State College	863-8582	

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

United States Geological Survey Landslide Hazards Program; Utah Division of Emergency Services and Homeland Security

Summary List Of All Problem Statements By Group

The following is a complete list of Problem Statements considered by the various discipline groups, organized by group. Within each group, the Problem Statements are listed in sequential order, based on the number assigned before the workshop. On the left side is shown the "Priority" determined by the group. Those Problem Statements that were selected for funding are indicated with an "*" next to the Priority number. Those Statements without priority numbers were deemed lower priority and not assigned a number. Some Problem Statements were considered by multiple groups, and have unique Statement numbers in each group. Cross-reference numbers are shown beneath the title. If the Problem Statement was selected for funding under another number, that is noted.

Following this list, the full text of each non-funded Problem Statement is given, organized by group and by number within the group. Those Problem Statements that were listed for funding were given in the previous section of this report, and will not be repeated here.

Priority	Prob No.	Problem Title	Approx Budget
GROUP 1:		**CONSTRUCTION**	
1*	05.01-1	Mitigate Queue Lengths in Work Zone Traffic Control	$50,000
	05.01-2	Use of Work Zone Crash Histories- Data Mining Project	$25,000
2*	05.01-3	Worker Visibility	$25,000
GROUP 2:		**MAINTENANCE**	
	05.02-01	Pavement Distress in 3/8" vs. 1/2" HMA-Thin Overlays	2ea. $170,000
1*	05.02-02	Cost-effectiveness & Indicators-Pavement Rejuvenation	$80,000
	05.02-03	Anti-icing Safety Evaluation	$12,000 to $25,000
4	05.02-04	Recessed Retroreflective Pavement Markers	$6,000
	05.02-05	Traffic Congestion & Unsightly Vehicle Accident Markings	
2*	05.02-06	Skid Index Trigger Values	
3*	05.02-07	Targeted and Adaptive Simulator Training for Winter Maintenance	$69,000

Priority	Prob No.	Problem Title	Approx Budget
GROUP 3:		**MATERIALS**	
2*	05.03-1	Asphalt Binder Uniformity	$90,000
	05.03-2	Update of "Good Roads Cost Less" Study	$40,000
3*	05.03-3	SMA Paving Mechanistic Properties	$100,000
1*	05.03-4	Full-Depth Recycling and Stabilization of Pavement Base Layers	$100,000
4	05.03-5	Calibrating Pavement Deterioration Models Using LTPP Data	$40,000
	05.03-6	Skid Index Trigger Values	$20,000
5	05.03-7	Simple Performance Tester FOP and Correlation	$50,000
	05.03-8	Hydrated Lime Introduction Process for Hamburg Wheel Tester	$40,000
5	05.03-9	Recycled Asphalt Mix Design Process	$80,000
	05.03-10	Crack Sealing or Joint Seal Bonding	$20 - 30,000
	05.03-11	Use of PG 70 –28 in Place of PG 64-34	$10 - 20,000

Priority	Prob No.	Problem Title	Approx Budget
GROUP 4:		**HYDRAULICS, ENVIRONMENTAL, ROADWAY**	
3*	05.04-1	Design & Development of a Context Sensitive Visual Resource Assessment and Management (VRAM) System for UDOT	$88,000
2*	05.04-2	Bridge Scour Countermeasure Phase II	$42,000
6	05.04-3	Regional Calibration of the Utah Run-off Curve Numbers & Parameters for SCS Methodologies, Phase II	TBD
8	05.04-4	Calibration of time parameters and synthetic unit hydrograph coefficients for Utah watersheds	$57,000
10	05.04-5	Streambed Stability In and Around Buried-Invert Culverts	$48,800
1*	05.04-6	Design Methods for Unique Culvert Installations	$35,000
7	05.04-7	An Assessment of the Impacts of Raised Median Installations	$50,000
9	05.04-8	Debris and sediment sampling in storm drain catch basins	$34,000 to $46,000
	05.04-9	New abutment design for bridges on small highly erodible stream channels	$39,000
	05.04-10	What is in Utah Roadway Runoff?	$16,000
5	05.04-11	Assess detention basin design and operation to determine water quality benefits, evaluate potential modifications to enhance water quality benefits	$50,000 to $75,000
4	05.04-12	Research/Define the Impacts of Highway Projects on Wildlife	$80,000 to $100,000
	05.04-13	3-D Design	unknown

Priority	Prob No.	Problem Title	Approx Budget
GROUP 5:		**PLANNING & ASSET MANAGEMENT**	
	05.05-1	How To Use the Mobility Data	$50,000
	05.05-2	UDOT Database Integration	
2*	05.05-3	Access Management Performance Index	$35,000
	05.05-4	Corridor Visioning	
4	05.05-5	Prioritization of Bicycle and Pedestrian Improvements	$20,000
	05.05-6	Creating an Emergency Evacuation Scenario Evaluation Tool for the Wasatch Front Region	$60,000
1*	05.05-7	Extract Vehicle Classification from TOC Video	$34,000
	05.05-8	Pros and Cons of Toll and HOT Lane Facilities	$30,000
	05.05-9	The Coordination of Roadway and Bridge Construction Projects	unknown
3*	05.05-10	Good Roads Cost Less	$20,000
5*	05.05-11	Determination of Crash Costs for Use in Benefit/Cost Analysis	$20,000

Priority	Prob No.	Problem Title	Approx Budget
GROUP 6:		**ITS / TRAFFIC & SAFETY**	
	05.06-1	Durability of Paint Pavement Markings	$15,000
	05.06-2	Highway Advisory Radio-Evaluation, Standardization & Innovation	$50,000
	05.06-3	Skid Index Trigger Values	$30,000
	05.06-4	Alternative Methods of Measuring Pavement Surface Conditions	$135,000
	05.06-5	Validating Work Zone Queue-Caused Delays Estimated by DELAY Enhanced v.2 Software w/ Field Data and Simulation and Shockwave Analysis Techniques	$20,000
1*	05.06-6	Advanced Warning Signal Site Selection Evaluation Matrix	$35,000
3*	05.06-7	Access Management/Traffic Impact Analysis Training	$30,000
2	05.06-8	Utah Intersection Safety: Issues, Contributing Factors & Mitigations - Further Study	$45,000
	05.06-9	Electronic License Plate Recognition System Testing	$130,000
	05.06-10	Evaluation of and Potential for Improvements to Bicycling Safety in Utah	$35,000
4	05.06-11	Impacts of Pre-emption on Signalized Intersections	$30,000
	05.06-12	Time Factor in Analysis of Work Zone Related Crashes	$35,000
	05.06-13	Evaluate Accuracy of Truck Traffic Data and Develop a Truck Traffic Demand Modeling Procedure	$40,000
	05.06-14	Creating an Emergency Evacuation Scenario evaluation Tool for the Wasatch Front Region	$60,000
	05.06-15	Evaluate Effects of Changes in Law Enforcement Practices on Freeway Efficiency and Safety	$35,000

Priority	Prob No.	Problem Title	Approx Budget
	05.06-16	Development of a Ramp Metering Algorithm for Freeways in Wasatch Front: Ph. 1. Development of a Conceptual Framework for Incorporating Sockwave Propagation Characteristics in Ramp Metering Algorithms.	$35,000
	05.06-17	Development of a Ramp Metering Algorithm for Freeways in Wasatch Front: Ph. 2. Development of a Ramp Metering Algorithm and Evaluate Its Performance by Simulation	$50,000
	05.06-18	Determination of Crash Costs for Use in Benefit/Cost Analysis	$20,000
GROUP 7:		**GEOTECHNICAL**	
	05.07-1	Biotechnical Stabilization and the use of Phreatophytes	$12,000
2*	05.07-2	Programming of Strong Ground Motion Instrumentation of New Bridges	$30,000
1*	05.07-3	Dynamic Passive Pressure on Abutments & Pile Caps	$75,000
	05.07-4	Relating Large Strain Dynamic Properties with Small Strain Dynamic Properties of a Pile Group	$35,000
	05.07-5	Improved Performance of MSE Walls	$19,880
3*	05.07-6	Geophysical methods to prioritize mitigation options for SR-9 in the Coal Hill landslide area	$19,500
	05.07-7	Legacy Highway Strong Ground Motion Array	$16,000
4	05.07-8	Mitigation Design for Lateral Spread of Bridges	$33,000
5	05.07-9	CPT Correlations for Soil Classification and Shear Strength Parameters	$20,000
	05.07-10	Drained Strength, Stress-Strain and Bulk Modulus Parameters for the Bonneville Clay	$20,000
	05.07-11	Performance of pile to pile cap connections under lateral loads	$95,000
	05.07-12	Development of MSE wall inspection plan based upon failure mode analysis and risk assessment	$40,000
5	05.07-13	Recommended Methods and Unit Costs for Rockfall Hazard Mitigation	$19,800

Priority	Prob No.	Problem Title	Approx Budget
GROUP 8:		**STRUCTURES**	
1*	05.08-1	Improvement of Deck Concrete Mix Design and Curing Practices	$70,000
3	05.08-2	Install New Instrumentation on the Legacy Highway New Bridges	$20,000
2	05.08-3	Improvement of Abutments & Pile Caps Design	$75,000
	05.08-4	Selection of Optimal Design Methods of Curved Girder Bridges	Unknown

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RESEARCH PROBLEM STATEMENT

Problem Title: Use of Work Zone Crash Histories- Data Mining Project **No.: 05.1-2**

Submitted By: Darrell Giannonatti and Doug Anderson **E-mail:**

1. Briefly describe the problem to be addressed:

Safety in work zones is a high priority for UDOT. Construction projects are traditionally problem areas due to reduced number of lanes, narrow shoulders, increased congestion, construction vehicle movements, and other factors.

Utilizing historical information about work zone safety can be important to implement lessons-learned. Determining the appropriate traffic control plans and methods for each situation is the intent of this project. The Crash Data Delivery System can provide the information in an efficient manner.

This study would be an expansion of the study done by Robert Westover on "Positive Work Zone Separation".

2. List the research objective(s) to be accomplished:

1. Review the safety histories of all construction projects conducted between 1994 and 2003.
2. Identify trends and relative safety aspects of each project.
3. Determine traffic control techniques that have been effective, and which methods have not been acceptable.
4. Recommend policies, procedures and methods to increase safety and the flow of traffic in work zones.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Obtain a complete list of the construction projects that have been conducted between 1994 and 2003.

2. Determine the type of project, including reconstruction, overlays, AADT, beginning and ending milepoints, and other factors.

3. Conduct queries of the accident records through the Crash Data Delivery System. This would include before, during, and after data for each project.

4. Analyze the information to determine which project traffic control plans were effective and which projects were observed to have problems with crashes. The total number of accidents, accident rates, and severity will be considered.

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Experts at the U of U and BYU have experience in conducting data mining studies using the Crash Data Delivery System.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
A report documenting lessons learned related to work zone safety will be produced. The report will recommend any policies or guidelines for use in traffic control plans.

8. Describe how will this project be implemented at UDOT.
By understanding how well traffic control plans have performed in the past we can enhance work zone traffic control in the future.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
The traveling public will benefit through fewer crashes in work zones and less congestion.

10. Describe the expected risks, obstacles, and strategies to overcome these.
Improved traffic control in work zones could increase the bids on projects.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Darrell Giannonatti

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $25,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Region Traffic & Safety Coordinators			
B)	Region Construction Engineers			
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Pavement Distress in 9.5mm Asphalt vs 12.5mm Asphalt on thin overlays **No.:**05.02-1

Submitted By: Scott Nussbaum – Region One Maintenance **E-mail:**

1. Briefly describe the problem to be addressed:

Our field experience suggests that our 9.5mm asphalt with high grade AC10 oil is holding up better under heavy truck loading than 12.5mm asphalt with 64-34 PG oil, when placed at 1.5 inches to 2 inches. Both asphalts have been placed on I-84 in Western Box Elder County at 1.5-2 inches and the 9.5mm had less rutting and shoving after 1-3 years.

2. List the research objective(s) to be accomplished:

1. Can these findings be du;olicated?

2. Should we be using strictly 9.5mm with high grade AC10 for thin overlay, including betterments?

3.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Fund test to mill and pave in consecutive sections using both asphalts in different areas 200

2. Monitor sections for distress 48

3.

4.

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Mill and Pave sections in summer of 2005. Record distress 3 times in 2005 and 3 times in 2006.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT Staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Report

8. Describe how will this project be implemented at UDOT.

Hire contractor to mill pavement to desired depth and have UDOT maintenance crews repave sections. Have region pavement engineers track distress over time.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Longer lasting thin overlays.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Central Maintenance method engineers. Lynn Berhnhard

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $170,000 (2 ea 2mile sections)

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Tim Biel	Central Materials	965 4859	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Anti-icing safety evaluation. **No.:**05-02.3

Submitted By: Scott Nussbaum **E-mail:** snussbaum@utah.gov

1. Briefly describe the problem to be addressed:

1 Determine the effects of application of Magnesium Chloride and Sodium Chloride on skid resistance over time based on temperature and pavement surface. This is specific to anti-icing application on wet or dry pavement prior to a storm event.
2 Determine if a follow vehicle can contribute to public safety my keeping vehicles further from the application equipment.
3 Determine maximum application rates for PCC and AC pavements.

Under certain conditions, (high temperature, low humidity), we know that Mag Chloride forms a slick layer on top of the pavement. Is there a lesser skid resistance issue under normal application conditions? Is there a concern with application rate on an OGSC vs. PCC?

2. List the research objective(s) to be accomplished:

1 Within the normal application ranges of Magnesium Chloride and Brine, determine the skid resistance curves on the pavement to see if the lack of skid resistance is more significant than a wet pavement condition.
2 If there is a skid resistance issue, determine the affect of differing application rates on OGSC and PCC pavenment on skid resistance.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1.	Select control and test sections for evaluation.	40
2.	Evaluate pavement condition, skid resistance, under normal conditions, record skid resistance.	160
3.	If skid resistance is an issue, test differing application rates and associated skid resistance.	200
4.	Publish results	80

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Conduct research during the winter of 2005-2006.
Publish results, Spring 2006.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT Materials / Pavement experts, or a consultant would probably be the best choice.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A technical report detailing the findings so that we are aware of the effects of our anti-icing applications on skid resistance.

8. Describe how will this project be implemented at UDOT.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT maintenance will benefit from a safety analysis by making the best decisions for anti-icing operations for public safety.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Perhaps someone from Central Maintenance.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $12 ,000-$25,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)		Scott Nussbaum, Region One Maintenance, 801-620-1637		
B)		Norton Thurgood , Area Supervisor, 435-757-3721		
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

UDOT Central Maintenance.

RESEARCH PROBLEM STATEMENT

Problem Title: Recessed Retroreflective Pavement Markings **No.:**05-02.4

Submitted By: Jef Garney **E-mail:** Jgarney@utah.gov

1. Briefly describe the problem to be addressed:

Wet weather makes it difficult to see pavement markings. There are different methods available to improve visibility of pavement markings in wet weather including raised pavement markers, wet weather reflective tape, and painting on center rumble strips. A test section for each of these methods should be implemented and studied for effectiveness in helping drivers distinguish between lanes in wet weather.

2. List the research objective(s) to be accomplished:

1. Install a test section for each method of improving visibility of pavement markings in wet weather.
2. Study effectiveness and feasibility of implementation for each method.
3. Create a standard for installing different pavement markings if justified by the study.

3. List the major tasks required to accomplish the research objective(s):

	Estimated person-hours
1. Research the markings	40
2. Find locations for installation (test sections)	40
3. Coordinate with project engineers (orange book?)	20
4. Install Markings	20
5. Evaluate markings for performance	200

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Much of the preliminary planning has been accomplished and test should be implemented in the summer of 2005. 3M and Avery Dennison are willing to contribute the product for testing. Engineers have been contacted, and project locations are being finalized.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation X Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐
Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT Staff – Those familiar with the concept of retroreflectivity

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
1)Report detailing the effectiveness of the markings and the feasibility of implementing the installation of the markings on a larger scale.

8. Describe how will this project be implemented at UDOT.
Lynn Bernhard of Maintenance Planning is working with Research and Traffic and Safety to implement the project

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
This project is intended to benefit the traveling public by improving the visibility of pavement markings in wet weather conditions. Improving visibility will enhance safety by helping drivers to distinguish between travel lanes.

10. Describe the expected risks, obstacles, and strategies to overcome these.
Risks-This is a relatively low-risk project. The markings do not have cast iron housings, so that eliminates a possible hazard. One obstacle is to convince stations supervisors that these are very much different than the past used plowable markers. I will communicate with them and have already initiated this.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Lynn Bernhard, Methods Engineer for Maintenance Planning.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $6000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Dan Betts	Region Two Paint	910 2430	N
B)Lynn Bernhard	Central Maintenance	964 4597	Y
C) Michelle Page	Research	965 4333	N
D) Vincent Liu	Methods Engineer – Central Maintenance	965 4077	N
E) Barry Sharp	Research	965 4314	Y
F) John Leonard	Traffic & Safety	965 4045	N
G) Rich Clarke	Engineer for Maintenance	965 4120	Y

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: Dr. Gene Hawkins, TTI 1-979 845 9946 and Lloyd Neeley, Maintenance Operations Engineer 801 965 4789

RESEARCH PROBLEM STATEMENT

Problem Title: Traffic Congestion and unsightly markings created by Vehicle Accident Investigation **No.:**05-02.5

Submitted By: Scott Nussbaum and John Leonard **E-mail:**

1. Briefly describe the problem to be addressed:

UDOT goes to great effort to create a safe transportation facility, however accidents do happen. It has been observed the investigation of the incidents seem to create confusion that does not facilitate orderly traffic flow, especially when local governments public safety are involved. Often response vehicles are parked in the only passage lane, during night investigation headlights of multiple vehicles are on bright with wigwag employed shining directly into opposing traffic blinding drivers. There is no standardization of accident traffic management. Officers appear to be conversing and being spectators rather than assisting the situation.

After the investigation safety barriers and other devices are left with unsightly painted markings, which last many months after the incident occurred.

Strategic Goal: Preservation X Operation X Capacity X Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop more effective ways to investigate incidents that indicate what has happened, using state of the art technology. Reduce the number of people involved or required.

2. Employ scene supervision under MUTCD traffic control guidelines and tools.

3. Find better ways than paint to mark relevant locations, that don't mar the devices. Then train those involved.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Understanding of scene investigation and requirements.

2. Knowledge of new concepts, dynamics, and instruments to gather all data that diagram the situation in a usable format.

3. Knowledge of most effective traffic management.

4. Convey the importance of restoring traffic flow

5. Provide education for the all parties involved.

6. Develop better ways to identify key scene points

4. Outline the proposed schedule (when do you need this done, and how we will get there):

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
More effective traffic management during the accident.
New techniques for more rapid and accurate scene investigation.
Traffic flow restored more quickly

8. Describe how will this project be implemented at UDOT.
Through policies, procedure, and legislative law.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
Reduced congestion and related delays,
less ancillary accidents, less residual marking after cleanup,
more professional display of effort.

10. Describe the expected risks, obstacles, and strategies to overcome these.
Break agency turf barriers.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Traffic and Safety division.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study: Public Safety, UHP.

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)		Department of Public Safety		No
B)	John Leonard	Traffic & Safety and anyone he assigns	965 4045	Yes
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Update of "Good Roads Cost Less" Study No.: 05.3-2

Submitted By: Gary Kuhl E-mail:

1. Briefly describe the problem to be addressed:

Evaluation of current User Cost, Pavement Life, Pavement Treatment Life, and appropriate Pavement goal(s) to optimize funding and maximize pavement performance & user benefits.

Strategic Goal: X Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Review and complete update of 1977 research effort using current cost and dTims pavement performance model.
2. Identify Pavement Performance Goal
3. Identify optimum system condition & funding stream required to get there.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Conduct a literature search to determine how other states are managing their pavement systems.
2. Evaluate Utah's highway system and recommend a set of target pavement condition levels that is appropriate.
3. Determine pavement rehabilitation and maintenance strategies to extend the life of Utah's pavements, and optimize the life-cycle cost of the system using dTIMS program output..
4. Estimate the cost of each rehabilitation and maintenance program needed to meet the system goals using dTIMS. .
5. Develop a short and long-range plan, including all tasks, costs, and schedules required to meet the pavement management targets.
6. Publish all information in a final report.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin summer or fall of 2005 and complete in 12 to 15 months.

5. Indicate type of research and / or development project this is:

Large: X Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A final report is needed that would contain a complete pavement management plan.

8. Describe how will this project be implemented at UDOT.

Finding for the program will be requested. Based on the approved budget, rehabilitation and maintenance programs will be appropriated to match the existing conditions on our highway system.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Utah's pavements will last longer and provide a safer transportation network.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Gary Kuhl

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)				
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Calibrating Pavement Deterioration Models Using LTPP Data **No.: 05.3-5**

Submitted By: Spencer Guthrie and Nathan Lee

E-mail: guthrie@byu.edu
nlee@utah.gov

1. Briefly describe the problem to be addressed:

Using accurate pavement deterioration models is important for predicting network- and project-level pavement condition. Forecasting pavement condition is critical for optimum programming of maintenance, rehabilitation, and reconstruction activities. While default deterioration models are often included in commercially available software, they must be calibrated for specific pavement types, materials, and climatic factors. UDOT would benefit from using improved deterioration models in pavement management practices. Calibrated models could be developed from information provided in the Long-Term Pavement Program (LTPP) for numerous sites in Utah. This project differs from the current Research project (##) due to its focus on the dTIMS models.

Strategic Goal: (Check all that apply) ☒ Preservation ☐ Operation ☐ Capacity ☐ Safety

2. List the research objective(s) to be accomplished:

1. Calibrate pavement deterioration models using LTPP data for different pavement types and different distresses
2. Focus on Modeling

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours: 1200**

1. Identify LTPP and other applicable sites in Utah and neighboring states relevant to the research.
2. Obtain performance data for each site using DataPave Online and owner condition data.
3. Compare collected data to predictions made using current deterioration models.
4. Calibrate models to ensure improved performance predictions.
5. Specifically address PCCP modeling and trigger values
6. May include the inclusion of new "Utah LTPP" sites
7. Coordinate with SuperPave research project noted above

4. Outline the proposed schedule (when do you need this done, and how we will get there): (12 month proposed timeframe)

Given the ready availability of pavement performance information through DataPave Online, field data could be collected and analyzed within two to four months. Evaluating existing deterioration models and developing the final calibrations may require an additional four months each.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Report documenting development of improved deterioration models
2. Recommended pavement life curves for use in pavement management processes
3. Data library for rehabilitation strategies for dTIMS modeling.
4. Identify further research needed as it relates to the Mechanistic-Empirical design guide.

8. Describe how this project will be implemented at UDOT.

UDOT engineers will input the calibrated models into their pavement management software.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Improving the ability to predict pavement condition will ultimately enable more accurate benefit-cost analyses, produce more accurate estimates of network- and project-level pavement condition, facilitate more accurate projections of funding needs, and improve the overall programming process.

10. Describe the expected risks, obstacles, and strategies to overcome these.

None

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Nathan Lee, Pavement Management Engineer, 801-399-0351

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Bruce Vandre	UDOT State Office	801-965-4835	y
B) Austin Baysinger	UDOT State Office	801-965-4846	y
C) David Blake	UDOT Region 2 Materials	801-975-4843	y
D) Mike Darter	ERES, Inc.	217-356-4500	n
E) Bill Lawrence	UDOT Program Development	801-965-4560	y
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Skid Index Trigger Values **No.: 05.3-6**

Submitted By: Lloyd R. Neeley **E-mail:** lneeley@utah.gov

1. Briefly describe the problem to be addressed:

UDOT currently has in place a guideline for which values of skid index are considered standard, marginal, or deficient. UDOT practice is for Program Development to notify the Regions when skid index values for a section of pavement become deficient, and to advise them to program a corrective treatment, and to post the section as "Slippery When Wet" until such time that a corrective treatment can be applied. Logically, however, some values of skid index present more of a hazard than others. The intent of this problem statement is to determine what value of skid index would require UDOT to take immediate corrective action, as opposed to merely placing a corrective treatment on the program.

2. List the research objective(s) to be accomplished:

1. Establish values of the skid index which would trigger immediate corrective action.
2. By functional classification, either reconfirm the existing values, or establish new values of skid index that should be considered as standard, marginal, or deficient.
3. Produce a report that explains the relationship between skid index and level of hazard in practical terms.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Review and summarize UDOT's original research used to establish the existing guideline.
2. Review and summarize measures used in other states to quantify skid resistance, reporting of those measures to interested parties, and trigger values for corrective action. Report on any differences between UDOT's measures and those used in other states.
3. Investigate and report on the relationship between UDOT's skid index and other material properties related to skidding such as the coefficient of friction.
4. Use UDOT accident data and skid data, for different functional classifications, to investigate statistical relationships between wet weather accidents and various values of skid index. Combine functional classifications as necessary to obtain statistically valid sample sets. Identify the most clear relationships, with emphasis on distinctions between levels of hazardous condition.
5. Recommend values of the skid index which should be considered standard, marginal, deficient, and seriously deficient (requiring immediate corrective action).
6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, in combination with UDOT staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- Report describing the original research used to establish UDOT's current guideline and practice, describing other states' practices, and describing the meaning of the skid index in both theoretical and practical terms.
- Report describing the current research effort, including data used, analysis methodology, and results and conclusions.
- Recommended UDOT policy and procedure on collection and use of skid data, and on indicated corrective measures for identified deficient pavements.

8. Describe how will this project be implemented at UDOT.

Based on the recommendations from the research, UDOT will establish a policy and procedure that outlines collection, data reduction, and reporting of skid index data, and establishes by functional classification which values of skid index should be considered standard, marginal, deficient, or seriously deficient, and what action(s) should be taken based upon those values.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Bill Lawrence

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Bill Lawrence	UDOT Program Development	965-4158	
A) Lloyd Neeley	UDOT Central Maintenance	965-4789	
B) Gary Kuhl	UDOT Program Development	964-4552	
C) Nathan Lee	UDOT Region 1	(801)620-1606	
D) Doug Anderson	UDOT Research	965-4377	
E) Russ Scovil	UDOT Program Development	965-4097	
F)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA, UDOT Traffic and Safety, UDOT Risk Management

RESEARCH PROBLEM STATEMENT

Problem Title: Simple Performance Tester FOP and Correlation **No.: 05.3-7**

Submitted By: Tim Biel **E-mail: tbiel@utah.gov**

1. Briefly describe the problem to be addressed:

We are purchasing 5 Simple Performance Testers as part of the Mechanistic-Empirical Design Guide implementation. A Field Operating Procedure and correlation program must be developed to insure the integrity of the tests performed.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Establish a new SPT FOP

2. Develop an SPT Correlation Practice

3.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Literature Search

2. Communicate with AASHTO

3. Draft FOP

4. Identify Training Requirements, including target audience

5. Attend SPT Manufacturer training session in July, 2005

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Equipment will be functional in August of 2005, testing for other programs should commence by November, 2005

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
XOther_Development Effort___

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University or consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Documented FOP section in the Materials MOI, and a report of training to implement

8. Describe how will this project be implemented at UDOT.

Inclusion in MOI, TTQP

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Needs to be done to make the $350,000 worth of equipment functional

10. Describe the expected risks, obstacles, and strategies to overcome these.

None

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Kevin VanFrank, Central Materials Division

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $50,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Kevin VanFrank	UDOT Materials Division, Materials Research Engineer	801-965-4426	
B) Desna Bergold	UDOT Materials Division, Training Coordinator	801-965-4512	
C) Larry Gay	UDOT Region 4, Region Materials Engineer	435-896-1306	
D) Steve Niederhauser	UDOT Materials Division, Bituminous Lab Engr. Asst.	801-965-4293	
E) Karen Olsen	UDOT Region 4, Materials Lab Engr. Asst.	435-896-1306	
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Hydrated Lime Introduction Process for Hamburg Wheel Tracker **No.: 05.3-8**

Submitted By: Tim Biel **E-mail: tbiel@utah.gov**

1. Briefly describe the problem to be addressed:

We are currently experiencing significant discrepancies between laboratory mix design characteristics when hydrated lime is introduced into the lab or field mixes in different manners. The issues need to be identified and a procedure established that will provide acceptable laboratory values that represent what is really happening in the field.

Strategic Goal: ☐ Preservation X Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Establish a new hydrated lime introduction process for Mix Design Verification

2.

3.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Identify variable parameters

2. Review Laboratory procedures

3. Review field production procedures

4. Develop steps in mix design process to minimize differences

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The sooner the better, as 100% of our mixes use hydrated lime, and we are in the implementation phase of the post-production testing with the HWT. The majority of our mix design are verified during the months of April through June.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
XOther _Development Effort___

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University or consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Updated mix design process section in the Materials MOI, and a report of issues to be careful of when tailoring the mix design process to an idividual HMA plant

8. Describe how will this project be implemented at UDOT.

Inclusion in MOI

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Will minimize the number of days at the start of a project where we will have poor mixes due to improper information form mix design.

10. Describe the expected risks, obstacles, and strategies to overcome these.

None

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Kevin VanFrank, Central Materials Division

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Kevin VanFrank	UDOT Materials Division, Materials Research Engineer	801-965-4426	
B) Tim Biel	UDOT Materials Division, Engineer For Materials	801-965-4859	
C) Larry Gay	UDOT Region 4, Region Materials Engineer	435-896-1306	
D) Stephane Charmot	Koch Asphalt Products	801-673-6579	
E) Mohammad Rahman	Granite Construction	801-944-5082	
F) Doug Watson	CMT Testing Lab	801-301-6361	
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Utah AGC, Colorado DOT,

RESEARCH PROBLEM STATEMENT

Problem Title: Recycled Asphalt Mix Design Process **No.: 05.3-9**

Submitted By: Tim Biel **E-mail: tbiel@utah.gov**

1. Briefly describe the problem to be addressed:

We are currently experiencing significant discrepancies between laboratory mix design characteristics and field mix performance for mixes that contain Recycled Asphalt Pavement. The issues need to be identified and a procedure established that will provide acceptable laboratory values that represent what is really happening in the field.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Establish a new RAP mix design process

2.

3.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Identify variable parameters

2. Review Laboratory procedures

3. Review field production procedures

4. Develop steps in mix design process to minimize differences

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The sooner the better, as 75% of our mixes use RAP. The majority of our mix design are verified during the months of April through June.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☒Other _Development Effort___

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University or consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Documented mix design process section in the Materials MOI, and a report of issues to be careful of when tailoring the mix design process to an idividual HMA plant

8. Describe how will this project be implemented at UDOT.

Inclusion in MOI

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Will minimize the number of days at the start of a project where we will have poor mixes due to improper information form mix design.

10. Describe the expected risks, obstacles, and strategies to overcome these.

None

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Kevin VanFrank, Central Materials Division

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $80,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Kevin VanFrank	UDOT Materials Division, Materials Research Engineer	801-965-4426	
B) Tim Biel	UDOT Materials Division, Engineer For Materials	801-965-4859	
C) Larry Gay	UDOT Region 4, Region Materials Engineer	435-896-1306	
D) John Butterfield	UDOT Region 3, Region Materials Engineer	801-975-4926	
E) Mohammad Rahman	Granite Construction	801-944-5082	
F) Doug Watson	CMT Testing Lab	801-301-6361	
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Utah AGC

RESEARCH PROBLEM STATEMENT

Problem Title: Crack Sealing or Joint Seal Bonding **No.:** 05.3-10

Submitted By: James Cox and Grant Wiley **E-mail:**

1. Briefly describe the problem to be addressed:

Study the various characteristics of joint sealing materials to determine which are the most effective. Determine if saw cuts in joints are properly cleaned to obtain the best bond. What is the best width of a joint? The effect of movement of concrete slabs to prevent bonding.

2. List the research objective(s) to be accomplished:

1. Characterize joint sealing materials for best bonding.
2. Determine if saw cuts are properly cleaned to obtain best bonding.
3. Determine the best width of a joint.
4. Evaluate the effect of movement of concrete slabs to prevent bonding.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Research manufacture's specifications
2. Field observations
3. Research previous projects and contact with maintenance personnel to determine effectiveness of bonds.
4. Analyze joint cleaning procedures. Actual tests to determine necessary cleaning procedures.
5. Simulate actual conditions with test specimens.
6. Check with industry to see if tests similar to these have been performed.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Within one year. Testing in summer of 2005. Research done in the fall and winter of 2005 and 2006.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, Industry (Crack sealing suppliers), UDOT Staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
What products are the most desirable? See industry develop a new sealer that can stretch and bond well. Better techniques for cleaning. What conditions to apply sealants under.

A report documenting the recommends. The report will recommend policy for use UDOT employees.

8. Describe how will this project be implemented at UDOT.

Results will be incorporated at construction and then throughout the life of the pavement.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Longer life of pavements. Less penetration of water into subgrade.

10. Describe the expected risks, obstacles, and strategies to overcome these.
No crack materials presently appear to work.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): James Cox and Grant Wiley

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $20,000 to $30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Joint sealer manufactures			
B)	Maintenance at UDOT			
C)	Concrete sawing companies			
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:
Cities and counties

RESEARCH PROBLEM STATEMENT

Problem Title: Use of PG 70-28 in Place of PG 64-34 **No.:** 05.3-11

Submitted By: James Cox and Grant Wiley **E-mail:**

1. Briefly describe the problem to be addressed:

Comparison of pavements to be constructed of each material. Determine from the results which binder would be the most desirable. In specifying for design which is the better to use in this area?

Strategic Goal: X Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Determine the quality of the binder.
2. Determine the characteristics of the binder.
3. Determine the life of the material the binder is used in.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Asphalt binder tests.

2. Research projects using each to determine life.

3. Testing of prepared samples such as Hamburg

4..

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Within one year. Testing in summer of 2005. Research done in the fall and winter of 2005 and 2006.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and/or UDOT Staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
A report as to what is recommended for this area.

8. Describe how will this project be implemented at UDOT.
Results would be incorporated into pavement designs.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
Long life of pavement.

10. Describe the expected risks, obstacles, and strategies to overcome these.
Availability of materials.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): James Cox and Grant Wiley

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $10,000 to $20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Asphalt binder suppliers			
B)	Hot mix suppliers			
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:
Cities and counties

RESEARCH PROBLEM STATEMENT

Problem Title: Regional Calibration of the Utah Run-off Curve Numbers & Parameters for SCS Methodologies, Phase II No.: 05.04-3

Submitted By: Michael Fazio – Denis Stuhff E-mail: mfazio@utah.gov

1. Briefly describe the problem to be addressed:

UDOT has typically used the rational method of analysis for small basin hydrology (up to 200-300 acres) while the USGS regional regression equations are preferred for larger basins. However, often the results from the regression equations (particular for the Region 6 equation of Utah) have such high errors that the estimates are practically unusable. The NRCS runoff curve number methodology offers an alternative solution for larger basin runoff estimation. It can be used in areas like Region 6 where confidence in the regression equations is low and in some of the other regions as a useful comparison. The biggest problem with the runoff curve number approach is that it has never really gotten all the research it deserves for Utah climatology, land use, and topography. Yet, it is so robust and stable a model that it is useful even when the values used are non-optimal. The following research should be done in order to provide guidelines on how it can best be applied to ungaged watersheds in Utah.

2. List the research objective(s) to be accomplished:

1. Select representative basins in Utah for calibrating CN numbers

2. Use existing rainfall/run-off to model CN numbers for Utah regions. Install stream gages and/or rain gages in needed areas. Collect data for modeling CN numbers

3. Adjust CN numbers for the arid & semi-arid climate zones of Utah.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Research location that have rain gages and stream gages

2. Determine possible sites for installation of stream gages and rain gages

3. Collect necessary data

4. Extrapolate curve numbers and typical rainfall distribution for various hydrologic regions in Utah

5. Prepare report

6. Place information in the Roadway Drainage Manual and computer programs

4. Outline the proposed schedule (when do you need this done, and how we will get there):

This project could be completed in 2 to 4 years. The data collection may take 2 to 3 years. After collecting the data, the researcher will need to use mathematical models to extrapolate the needed information, this task may take 6 to 12 months. The report and implementation following the completion of the other parts of the study may take 2 to 3 months.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A report and a manual would be the expected results from this research

8. Describe how will this project be implemented at UDOT.

The new curve numbers will be placed in the UDOT Manual of Instruction – Roadway Drainage and in the software used by UDOT designers to compute drainage run-off.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The results from this research would help refine the run-off calculations for un-gauged drainage basin (the majority in Utah), helping the designer make better predictions of the run-off crossing highway facilities.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Lack of data. Installation of rain gages and stream gage and the collecting of the data during a period.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Michael Fazio, Denis Stuhff, Tim Ularich

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Dr. Nelson	Brigham Young University	422-7632	√
B) Dr. Miller	Brigham Young University		√
C) Brent Jensen	UDOT		√
D) Jerry Chaney	UDOT		√
E) Kevin VanFrank	UDOT		
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

AGRC, State Engineer, Consultants, City Engineers, County Engineers, US Corp of Engineers

RESEARCH PROBLEM STATEMENT

Problem Title: *Calibration of time parameters and synthetic unit hydrograph coefficients for Utah watersheds* No.: 05.04-4

Submitted By Sanja Perica, University of Utah E-mail: perica@eng.utah.edu

1. Briefly describe the problem to be addressed:

Because of the importance of runoff timing, most hydrologic models require a watershed characteristic that reflects the runoff travel time. The most frequently used time parameters in hydrologic models are the time of concentration and the lag time. Time parameters for hydrographs for ungaged watersheds are usually estimated using empirical formulas. For example, a lag time is defined in terms of the physical characteristics of the watershed, such as drainage area, channel length and channel slope. However, most of these formulas have been based on very limited data and should be used with considerable caution for watersheds in which physical characteristics are different from those of the watersheds used to calibrate the formula and that are outside the geographic region for which the formula was developed. For example, the widely used Kirpich's formula for lag time was developed based on a study of small agricultural watersheds in Tennessee. The hydrographs developed using the commonly used NFF Regression Equations default to parameters developed for Georgia. No studies are available for semi-arid Utah watersheds. It is no surprise that when tested on a watershed in Utah (Red Butte Canyon, 7.2 mi^2), lag time estimates for the watershed varied from 12 minutes to 7 hours, depending on the formula used.

2. List the research objective(s) to be accomplished:

1. *Major objective*: To develop reliable estimates of lag time and time of concentration parameters for typical Utah watersheds.

2. To provide regional estimates of empirical coefficients used in most accepted synthetic unit hydrograph methods; such as a peaking coefficient needed for Snyder's synthetic unit hydrograph method and a storage coefficient used in Clark's method.

3. To create a regional synthetic unit hydrograph to be used in hydrologic models, such as HEC-HMS (HEC-1), for rainfall-runoff transformation

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Develop a database of short-interval (5-, 10-, 15-min) rainfall and runoff data for as many rural watersheds in Utah as possible.

2. Use watershed modeling system (WMS) software to estimate a number of physiographic characteristics of each watershed that will be explored as possible predictors of time parameters.

3. Estimate lag time and time of concentration parameters based on collected rainfall-runoff events.

4. Develop empirical equations that will relate lag time parameter to selected watershed characteristics.

5 Use HEC-HMS program to calibrate empirical coefficients of two existing and widely used synthetic unit hydrograph methods, or, if feasible, develop a new synthetic unit hydrograph for the region.

6. Depending on the number of watersheds that will be available for analysis, a regional analysis, or separation of watersheds based on land uses, may be attempted.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

It is estimated that approximately 18 months will be needed to complete the project:
6 months for data collection, quality control and database development
6 months for HEC-HMS and WMS runs
6 months for model calibration.

5. Indicate type of research and / or development project this is:

Large: X Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Short Manual containing practical examples, demonstrating how to apply these coefficients to common problems.

8. Describe how will this project be implemented at UDOT.

The Manual will be distributed to Region Roadway Designers & Hydraulic Engineers and incorporated into the Departments Hydraulic Manual of Instruction for the use of Consultants and others doing drainage designs for the Department.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The availability of Regionally calibrated hydrographs will allow flood routing and the optimal sizing of drainage structures. This will minimize both structure costs and environmental impacts.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Selection of appropriate Regionally representative gaged drainage basins. Using the knowledge of Statewide conditions, which have been acquired by previous Regression Equation work within Utah, and bounding States will facilitate this problem.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Denis Stuhff, UDOT Hydraulic Engineer.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):$57,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Dr. Sanja Perica	University of Utah		X
B)	Michael Fazio	UDOT Central Hydraulics		X
C)	Tim Ularich	UDOT Central Hydraulics		X
D)	Jerry Channey	UDOT Environmental Division		X
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Streambed Stability In and Around Buried-Invert Culverts **No.: 05.04-5**

Submitted By: Blake P. Tullis & Steven L. Barfuss **E-mail:blake.tullis@usu.edu**

1. Briefly describe the problem to be addressed:

A common practice for culvert designs, which emphasis fish or debris passage, is to bury the culvert invert. This provides a wider flow path at low flow rates, which reduces the velocities approaching, passing through, and exiting the culvert. A current National Cooperative Highway Research Program study (15-24) being conducted at the Utah Water Research Lab (USU) is evaluating the hydraulic performance of buried invert culvert, with respect to inlet loss coefficients and inlet control empirical relationships. An issue that has not been addressed is how to design stabile streambeds in and around buried invert culverts such that the material will not scour out below a certain design flow rate. Issues that influence the streambed stability included the shape of the substrate (rounded or angular), the size of the substrate, the makeup of the substrate (uniform or well graded material), the localized velocities and/or flow turbulence resulting from flow contraction and expansion.

2. List the research objective(s) to be accomplished:

1. Identify incipient motion velocities for various substrate materials, including both uniformly and well graded.

2. Identify regions of maximum scour potential and evaluate countermeasures where possible.

3. Identify the maximum flow rate at which a prescribed amount of scour occurs in each of the substrate materials.

* Tests conducted w/ 2-ft diameter circular, buried-invert culvert. Overall objective to provide info for use in a general spec. for culvert scour.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Literature and current practice review (120 person-hours)

2. Fabricating acrylic culvert (subcontract), adapting the test facility, substrate material collection. (300 person-hours)

3. Laboratory Testing (400 person-hours)

4. Report preparation (80 person-hours)

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

This project would likely extend over a 12 -month period. The bulk of the testing would be conducted during the Summer of 2005.

5. Indicate type of research and / or development project this is:

Large: X Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

A University with an active water research facility.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A technical report documenting the research results would be provided. A practical design example will be included in the report.

8. Describe how will this project be implemented at UDOT.

The design recommendations will be incorporated into the Departments Design Manual of Instruction and will provide general guidelines for commonly occurring culvert installations.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Everyone involved in transportation (private, commercial, etc.) benefit from culverts that operate safely and according to design. Failed culverts under roadways represent a potentially significant inconvenience to transportation. Besides public safe and welfare, buried invert culverts that do not function properly can impair fish and debris migration, creating environmental concerns.

10. Describe the expected risks, obstacles, and strategies to overcome these.

While it is not possible to fully predict experimental results in advance it is believed that this study would hopefully provide some general guidelines for commonly occurring culvert installations as well as good direction to future studies. General scour issues have been studied for many years. The fact that many of the problems related to scour have not been solved, suggests that a comprehensive design method for stabilizing substrate in and around all possible culverts configurations is not a likely result from this study alone. The biggest obstacle is likely the complexity of the scour problem. This study would be the first of a variety of studies needed to address the wide range of variables associated with the problem (culvert size, shape, substrate composition, engineered vs. locally available substrate materials, bed load transport through the system, etc.)

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Denis Stuhff, UDOT Central Hydraulics Engineer.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $48,800

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)		Michael Fazio UDOT, Central Division, Chief Hydraulic Engineer		X
B)		Tim Ularich UDOT Central Hydraulics Engineer		X
C)		Denis Stuhff, UDOT Central Hydraulics Engineer		X
D)		Jerry Chaney, UDOT Environmental Division		X
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

AASHTO, Federal Highway Administration, other State DOT's,

Alaska DOT is also interested in this study and is willing to cooperate financially (Mark Miles, ADOT&PF contact (907) 465-8893.

RESEARCH PROBLEM STATEMENT

Problem Title: An Assessment of the Impacts of Raised Median Installations **No.: 05.04-7**

Submitted By: Tim Boschert (UDOT), Grant Schultz (BYU) **E-mail:** tboschert@utah.gov gschultz@byu.edu

1. Briefly describe the problem to be addressed:

The purpose of this research problem statement is to evaluate the economic, safety, and public perception impacts before, during, and after construction on an unprecedented raised median and roadway reconstruction project on St. George Boulevard in Washington County. The results of this study will aid the Department in future raised median project proposals by providing results and recommendations from a current raised median project along with recommendations for future undertakings to help avoid problems that may arise.

The safety and economic impacts of raised median projects have been evaluated across the nation. The results of this research have generally indicated a positive impact on safety and a neutral impact on economics. A previous research project undertaken at Brigham Young University began the process of identifying the economic impacts of raised median projects in the state of Utah. UDOT is currently designing and will shortly begin construction on an unprecedented raised median project on St. George Boulevard in the city of St. George. This project provides an opportunity to evaluate the impacts of raised medians before, during, and after construction. These impacts include primarily economic and safety impacts, as well as public perception and the application of context sensitive solutions.

Strategic Goal: ☒ Preservation ☒ Operation ☒ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Evaluation of the safety and operational impacts of raised median projects before, during, and after construction.
2. Evaluation of the application of context sensitive solutions on raised median projects.
3. Evaluation of the economic impacts of raised median projects using tax records before, during, and after construction.

3. List the major tasks required to accomplish the research objective(s): 2 years Estimated person-hours 2,000

1. Literature review to establish the state of the practice on raised median project evaluation.
2. Data collection including tax records, crash data, construction documents, and public perception.
3. Identification of target locations along the corridor to evaluate before, during and after construction using previously collected data as a starting point for the research.
4. Establish technical advisory committee to evaluate the impacts of the raised medians, including local residents and staff.
5. Field test before, during and after construction as well as analysis of impact.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The recommended schedule for this project will coincide with the reconstruction on St. George Boulevard. It is recommended that the project begin by collecting background data prior to construction, with continuing evaluation through and following the construction period.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative:

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff joint participation.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables expected from this project would include: 1) evaluation of the safety and economic impacts of raised median projects before, during, and after construction; 2) documentation of observations, results, and recommendations from the study; 3) evaluation of the construction process with the intent of determining what could be done better on future projects; and 4) a presentation to UDOT staff on the results and future recommendations for the project.

8. Describe how this project will be implemented at UDOT.

This project will be implemented at UDOT through the access management program. The results of the study will be very useful in providing local data on the economic impacts of raised median projects, and the implications of context sensitive solutions in planning projects. The recommendations outlined as a result of this study will aid planners and designers with future project development.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from this project through an increased awareness of the impacts of raised median projects. The research conducted through this project would provide the basis on recommendations for future raised median projects not only in the state of Utah, but nationally as well.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Tim Boschert, Access Management/Program Coordinator, (801) 965-4175

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):$50,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Grant Schultz	Brigham Young University	(801) 422-6332	
B)	Troy Torgersen	UDOT Region 4 Traffic Engineer	(435) 893-4707	
C)	Aron Baker	St. George City Traffic Engineer	(435) 674-4274	
D)	Angelo Papastamos	UDOT Project Development	(801) 965-4561	
E)	Robert Clayton	UDOT Safety Programs Engineer	(801) 964-4521	
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: TRB Access Management Committee, NCHRP, City of St. George

RESEARCH PROBLEM STATEMENT

Problem Title: Debris and sediment sampling in storm drain catch basins No.: 05.04-8

Submitted By: Steven L. Barfuss and Blake P. Tullis E-mail: Barfuss@cc.usu.edu

1. Briefly describe the problem to be addressed:

Dealing with pollutants in storm water systems in an effective and economical manner is an ongoing challenge for UDOT as well as for DOT's nationally. Sediment and debris that finds its way into storm water systems can cause loss of capacity in the system and can pollute the water in the system. Spills due to accidents as well as thoughtless people who dispose of chemicals or urban wastes (leaves, soil litter, fertilizers, pesticides, street residuals) can also occur. Such upsets can cause significant localized increases of these pollutants and degrade water quality. Traction sands, chip sealing and tracked soil materials from raw construction sites and even wind born materials find their way into storm water systems. Minimizing the pollution associated with storm water can be costly or worse it can be both costly and ineffectual.

There exists a clear need to better define the fate of the oil and grease materials deposited on roadways by vehicular traffic. The forms and distribution of hydrocarbons and their byproducts within a functioning storm drainage system is not well defined. This is not surprising since the subject is manifestly a complex one. However what is surprising is how little data of a practical nature exists to aid the designers of common BMPs for highway pollutants. For example it is known that fuels and oils discharged onto roadways exists in several forms eg. (1) as free oil (seen rising to the surface of any standing water), (2) as mechanically emulsified oil (sometimes observed during the first portion of a rain event due to tire wash), (3) as chemically emulsified or dissolved oil, and significantly (4) as Oil-wet solids (where oil adheres to soil sediments and grit on the highway. It is believed that 60% or more of the total hydrocarbons deposited are taken up by the TSS in urban stormwater. Heavy metals are also associated with TSS loadings. The efficient removal of TSS in an appropriately designed treatment drain will clearly improve water quality in multiple ways. However there exists little data on the actual distribution of TSS in urban stormwaters, both locally and nationally. This project would create a database about the types of debris and pollutants found in catch basins in representative locations along the Wasatch Front, documenting the nature and order of magnitudes of typical pollutants and sediment size fractions and investigate the influence of the parent soils of the source catchments have a significant influence on the sediment size distributions in storm water systems in the State of Utah.

With this information, UDOT and others will be able to make better decisions about the management of pollutants and sediments in stormwater and the general public can be better educated about the problem.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. For a 12 month period monitor the contents of storm drain catch basins at approximately 50 sites along the I-15 corridor. Each site would be visited once a month and the nature of the pollutants and the associated sediments would be recorded.
2. Associated with each site would be an overview of the contribution drainage area (industrial, residential, etc.) and dominant soil type(s) with details regarding activity at the site.
3. Most of the debris would be replaced into the catch basin after each visit, so that normal process would occur.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Locate sites that provide diverse conditions for debris and other pollutant loading	200
2. Site visits over 12-month period	1200
3. Final report and summary tables	120

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project will take 15 months to complete. This will include a preliminary phase in available information concerning pollutants of interest and associated sediments are investigated in the State of Utah and appropriate sampling points for storm drain catchment basins are located. The second phase will be the sampling and analysis phase during which each of approximately 50 sites is visited. The final phase will include summarizing the results of the sampling program in report form. The preliminary phase will take 2 months to complete, the sampling and analysis phase will take 12 months to complete and the report phase will take 1 month to complete.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University. Graduate students will be utilized for much of the sampling work.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipement, training tool, etc.)

The final report will provide valuable and currently lacking information about the magnitude and nature of pollutants and sediments found in storm drain systems in Utah.

8. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Deliverables would include a final report, and a still photograph of each site and of typical debris that was found.

9. Describe how will this project be implemented at UDOT.
The results of these studies would be incorporated into UDOT's Hydraulic Manual for the use of the Departments Engineers and consultants when designing appropriate optimal storm water BMP's.

10. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This study will allow the optimal design of BMP's which will save dollars. It will insure that the best water quality values are achieved at the most economical costs. The collection of this data will establish the Department as one of the public agencies that is exhibiting a leadership role in the important area of water quality. The information could also be used to identify locations where inappropriate dumping of materials is occurring and provide opportunities for educating the public. Other beneficiaries will be sister agencies such as the DWQ which will be able to use the results.

11. Describe the expected risks, obstacles, and strategies to overcome these.
One of the obstacles with this project will be getting permission to make monthly site visits. This could take time and considerable effort. Help from UDOT maintenance folks in identifying safe and representative access to sampling points may be needed. If non-UDOT drains are being sampled the owner would need to be notified and permission to sample be secured. If such permission is not given help from UDOT in identifying alternative sample locations would be requested.

12. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Denis D. Stuhff of UDOT's Central Hydraulics Section

13. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $46,000, although if the time period for sampling were cut in half, the cost would be reduced to $34,000.

14. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended
A)	Steven L. Barfuss	of Utah State University	435-797-3214	X
B)	Blake P. Tullis	of Utah State University	435-797-3194	X
C)	Michael Fazio	UDOT Central Hydraulics		x
D)	Tim Ularich	UDOT Central Hydraulics		x
E)	Jerry Chaney	UDOT Environmental Division		x

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

The FHWA and the Utah Division of Water Quality

RESEARCH PROBLEM STATEMENT

Problem Title: New abutment design for bridges on small highly erodible stream channels No.: 05.04-9

Submitted By: Steven L. Barfuss and Blake P. Tullis E-mail: Barfuss@cc.usu.edu

1. Briefly describe the problem to be addressed:

This research would look at allowing sandy bank systems to erode naturally during flood events while protecting bridge crossings. Riprap and concrete overlays designed to protect the bank immediately upstream of bridge structures can collapse during these high flow rate events if the revetment is flanked and the supporting stream bank behind the protection collapses. Bridge abutment designs will be investigated that behave in such a way that as the upstream bank erodes exposing more and more of the bridge abutment, water will not get behind or under the abutment and will pass through the bridge as designed. To do this will require the angle of the abutment to be optimized and the lengths of the abutments to be extended. Laboratory modeling will help optimize the design of these types of abutments. Oftentimes in the past the focus of bridge scour research has been on how to mitigate the scour near the abutment. This proposed research will focus on diverting the energy of the flood away from the structure's foundation, allowing the scour to occur upstream naturally and safely during the flood event. It is felt that the proposed new abutment designs would be applicable to many of the perennial and ephemeral stream channels in southern Utah that are very susceptible to excessive bank erosion during large storm or flood events where it is not practical to stabilize the entire bank system to avoid erosion and it is difficult to fully stabilize only small limited sections of the banks.

2. List the research objective(s) to be accomplished:

1. Demonstrate a bridge abutment design which remains stable as the upstream bank naturally erodes, and the channel width expands exposing more and more of the bridge abutments, flood flows may still pass the structure without compromising the bridge's structural integrity.

2. Because we are focusing on highly erodible channels, the objective would be to change the direction of the river's energy instead of pursuing conventional scour control protection stategies.

3. The focus of this project is to provide appropriate safe and economical abutment designs for bridges located on small highly erodible channels

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Review abutment failures occurring in highly erodible channels using conventional abutment designs. 320
2. Utilize physical laboratory models to optimize length and angles of the proposed new bridge abutments. 800
3. Final report and drawings . 160

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project should take about 8 months to complete. The first phase would include the investigation of failures and commonly used design procedures. The 2nd phase would be laboratory testing of proposed bridge abutment designs in a hydraulic laboratory. The final phase will be the reporting phase.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, since graduate students will help with much of the work to reduce costs and because a research hydraulic laboratory could be utilized for the 2nd phase of the project.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Deliverables would include a final report, drawings of bridge abutment configurations, laboratory testing video and still photography

8. Describe how will this project be implemented at UDOT.

The department would have an alternative method of mitigating the scour hazard at existing high risk bridge abutments located in highly erodible channels. Additionally, new structures built over highly erodible channels could utilize the design to more economically mitigate the potential scour hazards using the techniques documented in this study.

9 Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The department will be able to provide safer bridges to the public for vehicle traffic and pedestrian walkways.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Proper selection of several channel widths to be modeled upstream and downstream of the model bridge to help optimize the required abutment structure configuration. Past channel performance will be used to select these widths. Similarly the modeling of erodible bank materials in a laboratory can be less than exact. Because of this, the project will look at flow characteristics as a result of various erosion extents and not necessarily the erodible material itself.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Steven L. Barfuss 435-797-3214 USU

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $39,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)		Blake P. Tullis of Utah State University	435-797-3194	
B)		Denis Stuhff UDOT Hydraulic Engineer		X
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA

RESEARCH PROBLEM STATEMENT

Problem Title: What is in Utah roadway runoff **No.: 05.04-10**

Submitted By: H. Sadik-Macdonald **E-mail:** hmacdonald@utah.gov

1. Briefly describe the problem to be addressed:

DEQ is concerned about how much salt and other chemicals runoff UDOT roadways and end up in waters of the state. Water samples should be collected from 4 or 5 representative sites for a couple of winter storms, and again during late summer storms. Published data is not from Utah and is more than 15 years out of date.

2. List the research objective(s) to be accomplished:

1. Runoff should be measured for Total Dissolved Solids (TDS), Volatile Organic Compounds (VOCs), Metals, Total Suspended Solids (TSS).

2 Compare above analytical results to water quality standards.

3. Determine if pretreatment is required before entering receiving waters.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. . Four storm events should be sampled, 2 winter, 2 late summer.

2. . The Div. of Water Quality should be consulted on appropriate sample locations and invited to participate in at least one collection event.

3. Monitor data collection for quality control and quality assurance.

4.

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Organize sampling tools and personnel.

Coordinate with DWQ.

Collect winter storm data before April 1 when snow has been plowed, salt applied.

Compare data with published water quality standards.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: x☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)? Staff or student

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
comparison tables, narrative of findings, proposed fixes – if any.

8. Describe how will this project be implemented at UDOT.
May affect roadway design and catchment basin construction.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
We will learn if roadway runoff needs to be treated prior to discharge.

10. Describe the expected risks, obstacles, and strategies to overcome these.
Reliance on data collected in other states that are not comparable in climate, geography, topography to Utah.
Reluctance to fund the costs.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Helen Sadik-Macdonald

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $16,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Lyle Stott,	Div. of Water Quality	538-6073	
B)	Ab Wakil	UDOT Research	964-4456	yes
C)	J. Chaney	UDOT Environmental	965-4317	yes
D)	Paul West	UDOT Environmental	965-4672	yes
E)	T. Johnson	UDOT Environmental	965-4598	yes
F)	Stan Adams	UDOT Environmental	965-4035	yes
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:
DWR, FHWA, USFS, USFWS, ACOE

RESEARCH PROBLEM STATEMENT

Problem Title: Assess detention basin design and operation to determine water quality benefits, evaluate potential modifications to enhance water quality benefits **No.: 05.04-11**

Submitted By: Karen Nichols, Stantec Consulting **E-mail:** knichols@stantec.com

1. Briefly describe the problem to be addressed:

Goup 4. Hydraulics and Environmental

Current design criteria for stormwater detention basins are based on water quantity requirements. UPDES discharge permits require the implementation of best management practices to reduce the discharge of pollutants to the maximum extent practicable. Existing basins and future basins can be physically modified to provide additional water quality benefits. An investigation to determine removal efficiency of suspended solids and other pollutants associated with urban stormwater discharges from transportation corridors for existing and modified detention basins would support regulatory requirements, for the UDOT UPDES Phase 1 Stormwater Discharge Permit (UTR) Post Construction Controls ( ). An assessment of operation and maintenance requirements for existing basins and modified basins would be conducted to determine maintenance schedules and disposal of sediment requirements.

2. List the research objective(s) to be accomplished:

1. Literature search on water quality benefits for storrmwater pollutants of concern of detention basins.

2. Review of design criteria for future stormwater detention basins and establishment of modification criteria for existing stormwater detention basins.

3. Establishment of operations and maintenance schedules for existing basins and modified basins.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours:** 600 –800 hours

1. Conduct literature search to determine stormwater pollutants of concern and their characteristics.

2. Review and establish design criteria for stormwater quantity and quality for future stormwater detention basins and potential modification to existing stormwater basins, to predict water quality benefits in accordance with post construction water quality controls requirements of the UPDES discharge permit.

3. Coordinate with State Division of Water Quality, stormwater and design sections, during the development of the criteria. Coordinate with UDOT legal, environmental, hydraulics and maintenance for design and implementation strategies to meet regulatory requirements.

4. Establish design procedures for future stormwater basin designs incompliance with water quality and water quantity requirements.

5. Conduct a detailed review of one UDOT transportation drainage basin, gather topographic data to evaluate capacity and hydraulic characteristics of existing basin, prepare conceptual design drawings for water quality benefit modifications. Prepare stormwater sampling plan and conduct water quality samples of existing basin, during two storm events, inflow and outfall, to assess actual water quality benefits of the existing basin.

The study is estimated at 600 hours, with an additional 200 hours for stormwater sampling….

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project would need to last at least 9 months to a year and span over spring or fall, in order to collect actual stormwater samples. Begin in Fall 05 and end in Spring 06.

5. Indicate type of research and / or development project this is:

Large: XX☐ Research Project ☐ Development Project

Small: ☐ Research Evaluation Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant, UDOT Staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Design method to incorporate water quality benefits, as well as meet water quantity discharge requirements. Documented design procedures with predictive pollutant removal efficiencies will assist the designers' meet environmental requirements.

8. Describe how will this project be implemented at UDOT.

During the design process, if storm water quality is a concern and a structural control is required, the evaluation of detention basins, prediction of sediment removal efficiencies and other pollutant removal efficiencies would be required. This process will assist the designers with criteria and procedures to design detention basins to serve as both water quantity controls and water quality benefits. This process will also outline and predict maintenance frequency and procedures for the detention basins.

If an existing stormwater facility is required to be modified to enhance water quality discharges, procedures for the design of the modification will be prepared to assist the designers.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The benefit of this project, is that the designers will understand the environmental criteria associated with stormwater discharges as well as the design criteria to produce a design that meets: 1) environmental criteria and permit conditions; 2) water quantity discharge requirements; and 3) minimum operation and maintenance requirements.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No risk is expected. Coordination between environmental, hydraulics and maintenance will assist with implementation.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Hydraulics—Denis Stuhff; Environmental –Jerry Chaney; Maintenance—Lynn Bernhard

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $50,000- $75,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Dave Rupp	DWQ	538-6146	No
B) Tom Rushing	DWQ	538-6146	NO
C) Dennis Stuhff	UDOT Hydraulics	965-4224	Yes
D) Jerry Chaney	UDOT Environmental	965-4317	Yes
E)Lynn Bernhard	UDOT Region 2 Maintenance		Yes
F) Kevin Van Frank	UDOT Region 2		Yes
G) Mike Fazio	UDOT Hydraulics		Yes

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Utah Division of Water Quality, Salt Lake County Engineering Division (provide stormwater sampling equipment, and assistance during sampling plan preparation)

RESEARCH PROBLEM STATEMENT

Problem Title: Research / Define the Impacts of Highway Projects on Wildlife No.: 05.04-12

Submitted By: Gregory Punske, Federal Highway Administration E-mail: Gregory.Punske@fhwa..dot.gov

1. Briefly describe the problem to be addressed:

Determine if highway projects have adverse impacts to wildlife and measure the direct and indirect impacts of highway projects on wildlife.

2. List the research objective(s) to be accomplished:

Develop and validate standardized protocols for the determination of highway impacts on wildlife. These will include scientifically defensible methods for:

- *Preconstruction wildlife surveys*
- *Effects monitoring during construction*
- *Post-construction monitoring*
- *Analysis and impact determination*
- *Mitigation design*

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. *Develop quantifiable measures of direct and indirect impact of highway on wildlife, including*

   - *Changes in species diversity, distribution and abundance*
   - *Changes in habitat quality, distribution and availability*
   - *Impacts of noise on wildlife*
   - *Impacts of light on wildlife*
   - *Impacts of human disturbance on wildlife*
   - *Impacts of highway associated pollutants on wildlife and their habitats*
   - *Develop standardized, scientifically defensible analysis procedures for these measures that allow consistent impact level determinations for different highway projects.*

4. Outline the proposed schedule (when do you need this done, and how we will get there):

- *1-2 year preconstruction surveys*
- *Construction monitoring for duration of construction phase*
- *5 year annual monitoring post- construction*
- *3 – alternate year post-construction monitoring after 5 year annual monitoring*

5. Indicate type of research and / or development project this is:

Large: XXX Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

- *Consultant with University collaboration*
- *Survey staff can come from consultant, university and/or agency staff*
- *Local long-term consistency and QC oversight by consultant, university or agency scientist(s)*

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- *Protocol manual for wildlife highway impact analysis*
- *Technical report and peer reviewed publications on specific studies conducted for protocol development*

8. Describe how will this project be implemented at UDOT.

- *Contract to consultant and/or University*
- *Participation in Technical Advisory Committee*

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

- *Increase efficiency and reliability of environmental review process for highway projects*

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

* *Bryan Adams, UDOT Legacy Parkway Project*

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): *$80,000 to $100,000*

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A		*Chris Witt - U.S. Fish and Wildlife Service*		
B)		*Bekee Megown, U.S. Fish and Wildlife Service*		
C)		*Dr. Ed West; Jones & Stokes/ UC Davis Road Ecology Center*		
D)		*Nancy Kang, U.S. Army Corps of Engineers*		
E)		*Brent Jensen, UDOT Central Environmental Unit*		
F)		*Gregory Punske, Federal Highway Administration*		
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

- *Transportation Research Board*
- *Utah Division of Wildlife Resources*
- *Federal Highway Administration*
- *U.S. Fish and Wildlife Service*
- *U.S. Army Corps of Engineers*

RESEARCH PROBLEM STATEMENT

Problem Title: HOW TO USE THE MOBILITY DATA **No.: 05.05-1**

Submitted By: Paul Vidmar **E-mail:** pvidmar@utah.gov

1. Briefly describe the problem to be addressed:

The Planning Division has started to develop a mobility system for the State roadway system. More needs to be done to establish a complete system and process that will fit into the overall goals of the UDOT for the State roadway system. We need to establish a system that can be used and adapted to the State's needs and a process that is sound. We need to have that system and the process be sound by finding what other entities who work with mobility are using and making sure that our system and process are supported. Once the system is in place, the Planning Division can gather data and use it fully once a usable, viable system and sound process is in place.

Strategic Goal: ☐ **Preservation** ☐ **Operation** X **Capacity** ☐ **Safety** (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Establish a mobility system and process.

2. Determining and researching what data will support the Mobility System and process.

3. Gathering the data and research that will support the Mobility System and process.

4.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours** 500

1. Establish a usable and viable mobility system with a sound process.

2. Literature search and other research to find what systems other states and metropolitan planning organizations are using in the mobility systems.

3. Gather the data and research supporting the system and process.

4.

5.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The Research Project needs to be done by January 2006. The project should take about 3 months for completion, starting in September 2005 with the determination of the system and project needed. The research and any needed interviews with key persons would happen over the next two months (October and November 2005). Gathering data from MPOs and other entities would take place December 2005.

5. Indicate type of research and / or development project this is:

Large: X **Research Project** ☐ **Development Project**
Small: ☐ **Research Evaluation** ☐ **Experimental Feature** ☐ **New Product Evaluation** ☐ **Tech Transfer Initiative** :
☐ **Other**_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Best type of entity to perform this project is a consultant with past experience in the field of Mobility and Data Management.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The first deliverable is a system and a process that fits the UDOT needs and goals. The second deliverable is research that supports the system by demonstrating the types of Mobility Systems and Processes used by other organizations today.

8. Describe how will this project be implemented at UDOT.

The system would be used to help Program Development, the Regions, and any other UDOT entity to help prioritize projects for the Long Range Plan and the STIP, in part, by using the data in the Asset Management as a factor to determine the most cost effective way to use the limited funds the State has.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The Mobility Data System would give us an idea of what we need to do to make our system work better with or without adding capacity. Those benefiting from the project would be Program Development, Project Development, the Regions, and eventually the public.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The main risk is that the scope of the project will grow to be too large. The main way to reduce this risk is to focus the entity with a proper scope and receive regular updates about progress and schedule. The biggest obstacle is that few public agencies have implemented this type of use for the Mobility Data that they may have. The entity performing this project will have to do some in-depth research to find out what the other agencies have done.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Paul Vidmar

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $50,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Glen Ames	UDOT / Program Development / Asset Management	965-4953	
B) Walter Steinvorth	UDOT / Program Development / Planning	965-3864	
C) Mike Kaczorowski	UDOT / Program Development / Planning	965-4152	
D) Chad Worthen	Mountainland Association of Governments	229-3811	
E) Mike Brown	Wasatch Front Regional Council	363-4230	
F) Rex Harris	UDOT Region 1	620-1605	
G) David Nazare	UDOT Region 2	975-4806	
H) Tracy Conti	UDOT Region 3	227-8001	

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: UDOT Database Integration **No.: 05.05-2**

1. Briefly describe the problem to be addressed:

The Department has several differing databases that collect and store a lot of the same information. This collection and storage of data should be merged into one database.

Strategic Goal: x Preservation x Operation ☐ Capacity x Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. An independent study to look at the databases in use and being developed.
2. Determine those that collect and store the same information.
3. Recommendation on how to merge, store and access the information.
4.
5.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Obtain a list and complete a review of Department databases. (40hrs)
2. Determine common information. (120 hrs)
3. Study and recommend how to merge, store and access the information. (120 hrs)
4.
5.
6.
7.

4. How will this project be implemented? (e.g. training, equipment, software, hardware, field demos, workshops, etc.)

X Improved asset ☐ Crashes reduced ☐ Environmental benefit X Enhanced efficiency ☐ Other

Long term implementation based on recommendations of the study.

(Please fill out other side of sheet as well.)

5. What deliverable(s) would you like to see? (e.g. useable technical product, technique, policy, procedure, specification, standard, software, training tool, etc.)

Useable report with recommendations.

6. Who in the Department could be the direct end-users of this study=s results?

All who manage and use databases. ISS Department.

7. How could the Department benefit from implementing the results of this study?

It will give the Department an outside opinion and direction regarding database collection and storage. It will give the Department an overall view of what effort will be required and what is possible in migrating and merging duplicate information currently in differing databases.

8. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

9. List the potential champions (people interested in and/or willing to participate in the Technical Advisory Committee for this study):

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Gary Kuhl	UDOT/Program Development/Complex	964-4552	Yes
B) Bill Lawrence	UDOT/Program Development/Complex	965-4560	Yes
C) Michelle Verucchi	UDOT/Program Development/Complex	965-4490	?
D)			
E)			
F)			
G)			

10. Identify other Utah agencies or groups that may have an interest in supporting this study:

☐ City ☐ County ☐ MPO ☐ Research Organization ☐ Private Industry ☐ University ☐ Other

List names:

11. Identify other regional/national agencies or groups that may have an interest in supporting this study:

☐ FHWA ☐ USGS ☐ EPA ☐ NCHRP ☐ TCRP ☐ State DOT=s ☐ Other

List names:

RESEARCH PROBLEM STATEMENT

Problem Title: CORRIDOR VISIONING **No.: 05.05-4**

1. Briefly describe the problem to be addressed:

There is compelling need for a long-range vision for each corridor of the state transportation system. Property owners, developers, local agencies, and all of UDOT, particularly permit officers, project managers, Right-of-Way and Structures, have an interest in the future vision of these corridors. This is especially true in projected growth areas. Each corridor vision should provide estimates of travel demand growth and an expectation of right-of-way needs that would accommodate multimodal solutions, including autos, freight, transit (bus, light and commuter rail, BRT), bicycles and pedestrians, as appropriate. An access management vision is needed to preserve and maximize the capacity of the corridor. At the same time, it is important to not predetermine a preferred alternative without the due process endorsed in UDOT's Context Sensitive Solutions philosophy.

2. List the research objective(s) to be accomplished:

1. Define a procedure outlining steps to establishing future visions for each state transportation corridor to be published in UDOT's long-range plan, paying particular attention to the appropriate amount of public and local government involvement needed to ensure the vision encompasses context-sensitive solutions and meets the standards of the National Environmental Policy Act (NEPA) for planning-level decisionmaking.

2. Include recommendations of which UDOT divisions and outside agencies need to be involved and at what stage,

3. Recommend a priority order of the corridors (existing and proposed) as to timing of evaluation.

4. Recommend a level of effort on each evaluation (in-house study vs. consultant, etc)

5.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1.

2.

3.

4.

5.

6.

7.

4. How will this project be implemented? (e.g. training, equipment, software, hardware, field demos, workshops, etc.)

☐ Improved asset ☐ Crashes reduced ☐ Environmental benefit ☐ Enhanced efficiency ☐ Other

UDOT Planning, in concert with the Regions, other UDOT divisions, MPOs and local officials, will use the recommendations of the study to evaluate each state transportation corridor, define a vision for the corridor, and publish the definition in UDOT's long-range plan. That information will then be available to the permit officers to determine right-of-way and access management needs on applications for developing parcels. UDOT project managers will be able to guide design and construction of projects in a way that accommodates future as well as current needs. Structural designs (many with a 70-year projected life) can anticipate future widths. Local governments and UDOT Right-of-Way will be in a better position to preserve corridors and accommodate multiple modes. Resource agencies will better understand the overall vision for the transportation network and make appropriate input.

The procedure may also be of interest to counties, MPOs, cities and towns as they work to define local transportation corridors outside the state system.

(Please fill out other side of sheet as well.)

5. What deliverable(s) would you like to see? (e.g. useable technical product, technique, policy, procedure, specification, standard, software, training tool, etc.)

Procedural recommendations, especially as to how to accomplish the visioning process within the intent of NEPA requirements.

6. Who in the Department could be the direct end-users of this study=s results?

Planning, Right-of-Way, Region/District permit officers, project managers

7. How could the Department benefit from implementing the results of this study?

Having the procedure defined and the resulting NEPA-ready corridor visions defined will greatly enhance both UDOT's and local governments' abilities in corridor preservation. It will also allow phased implementation of improvements that still accommodate future needs.

8. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

9. List the potential champions (people interested in and/or willing to participate in the Technical Advisory Committee for this study):

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Kevin Nichol	Planning	965-3853	
B)				
C)				
D)				
E)				
F)				
G)				

10. Identify other Utah agencies or groups that may have an interest in supporting this study:

☐ City ☐ County X MPO ☐ Research Organization ☐ Private Industry ☐ University ☐ Other

List names:

11. Identify other regional/national agencies or groups that may have an interest in supporting this study:

☐ FHWA ☐ USGS ☐ EPA ☐ NCHRP ☐ TCRP ☐ State DOT=s ☐ Other

List names:

RESEARCH PROBLEM STATEMENT

Problem Title: PRIORITIZATION OF BICYCLE AND PEDESTRIAN IMPROVEMENTS **No.:05.05-5**

1. Briefly describe the problem to be addressed:

Interest has been growing for several years, at UDOT, among local communities, and with the public at large, in providing new facilities to safely accommodate bicycles and pedestrians along state highway corridors. The interest is driven by a desire to improve safety, increase bicycle tourism opportunities, facilitate healthy activity for residents, and potentially reduce the demand for automobile travel. Unfortunately, while UDOT has volumes of data on motor vehicle usage available for its roadway project selection process, no such database exists for bicycle or pedestrian usage, beyond some crash statistics. A small, but significant amount of funding is available each year for bicycle- and pedestrian-related improvements. As popularity grows, additional funds may also become available. A systematic, cost-effective process is needed to determine the location of needed improvements statewide and to prioritize needs on long-term and annual bases so these funds may be used in the most effective manner. Such a procedure would also be very helpful if additional funds were to be identified from federal, state, local, or private sources.

2. List the research objective(s) to be accomplished:

1. Recommend a procedure for identifying bicycle and pedestrian needs statewide and prioritizing projects to meet those needs over the period covered in the UDOT long-range plan. The procedure would need to be capable of implementation prior to June 2006.

2. If appropriate for developing greater confidence in the results, recommend a separate procedure that could be implemented over a longer term (beyond the current LRP iteration) that would make use of collected data. Include recommendations on data type and amount to be collected and on cost-effective collection techniques.

3.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Literature search and other research to determine what other states, metropolitan planning organizations, and cities are using to assess their bicycle/pedestrian facility needs and how they prioritize spending on those facilities.

2. Evaluate the various data collection/analysis tools available and make recommendation on what UDOT should use.

3. Determine if it is appropriate to use some kind of warrant for each facility. If so, recommend a warrant analysis.

4. Recommend a procedure, based on information currently available, to prioritize the implementation of improvements to the state highway system to address bike and pedestrian needs, so that a financially responsible project-based long-range pedestrian and bicycle plan may be developed by June 2006.

5. If appropriate to more rigorously represent these needs, recommend a revised procedure, using additional data that could reasonably be collected, for use in long-range plan updates after 2006.

6. Identify stakeholders and potential funding sources for these improvements.

7.

4. How will this project be implemented? (e.g. training, equipment, software, hardware, field demos, workshops, etc.)

☐ Improved asset ☐ Crashes reduced ☐ Environmental benefit ☐ Enhanced efficiency ☐ Other

(Please fill out other side of sheet as well.)

5. What deliverable(s) would you like to see? (e.g. useable technical product, technique, policy, procedure, specification, standard, software, training tool, etc.)

Procedure for identifying and prioritizing bicycle and pedestrian needs associated with the state transportation system.

6. Who in the Department could be the direct end-users of this study=s results?

Planning, Regions

7. How could the Department benefit from implementing the results of this study?

The new procedure derived from the study would allow UDOT to plan and program projects to serve pedestrian and bicycle need and to do so in a logical, systematic, and repeatable fashion.

8. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $20K

9. List the potential champions (people interested in and/or willing to participate in the Technical Advisory Committee for this study):

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Kevin Nichol	UDOT Planning	965-3853	Y
B)	Sharon Briggs	UDOT Planning	964-4564	N
C)	Todd Hadden	UDOT Systems Planning & Programming		Y
D)	Michael 'Kaz' Kaczorowski	UDOT Planning		Y
E)	Jory Johner	WFRC		N
F)	Jim Price	Mountainland Assn of Governments		N
G)	Jane Lambert	Cardiovascular Alliance - UDOH		N

10. Identify other Utah agencies or groups that may have an interest in supporting this study:

☐ City ☐ County X MPO ☐ Research Organization X Private Industry ☐ University ☐ Other

Alliance for Cardiovascular Health – UDOH, Utah Division of Parks & Recreation, Utah Transit Authority
Salt Lake Mayor's Bicycle Advisory Committee (MBAC), Salt Lake County Bicycle Advisory Committee
Weber Pathways, Provo Bicycling Committee, Utah Travel Council, PTA
Bingham Cyclery, Bonneville Touring Club, Cache Trails Coalition, Parley's Rails, Trails and Tunnels Coalition (PRATT)
Three Rivers Trail Foundation, Mountain Trails Foundation, Color Country Cycling Club,

11. Identify other regional/national agencies or groups that may have an interest in supporting this study:

X FHWA ☐ USGS ☐ EPA ☐ NCHRP ☐ TCRP X State DOT=s ☐ Other

USDA Forest Service, National Park Service
REI, Adventure Cycling Association, Association of Pedestrian and Bicycle Professionals, Bikes Belong
International Walk To School, National Center for Bicycling and Walking, Walkable Communities Inc., America Bikes, America Walks

RESEARCH PROBLEM STATEMENT

Problem Title: Creating an Emergency Evacuation Scenario Evaluation Tool for the Wasatch Front region **No.:** 05.05-6

Submitted By: Prof. Mitsuru Saito **E-mail:** msaito@byu.edu

1. Briefly describe the problem to be addressed:

The Indian Ocean earthquake of magnitude 9.0 stunned the world by tsunami tidal waves killing more than 150,000 people in Asian and African countries surrounding the ocean. A BYU geology professor predicted a serious earthquake several years ago in the earthquake stricken area to the government of Indonesia. The same professor predicts that an earthquake of magnitude of 7.0 would hit the Wasatch Front anytime. The Wasatch Front region is surrounded by mountains and the mail artery that is the backbone is only interstate 15. When an earthquake hits the region, it is anticipated that I-15 will suffer serious damages and most likely damages bridges make I-15 impassable. How should UDOT prepare for this natural disaster? Though the dynamics of natural disaster makes it difficult to estimate what might happen, UDOT can simulate various levels and extent of damages of the highway infrastructure and prepare for such cases. In order to simulate such dynamic transportation situation, it is necessary that simulation models be equipped with a dynamic traffic assignment feature. FHWA has recently completed such planning level mesoscopic simulation model DYNASMART-P and the program is now available to simulate various what-if situations. Once a model of the region is created, it can be used for other situations such as traffic routing programs for large people gathering activities like football games and festivals.

2. List the research objective(s) to be accomplished:

1. Literature search for emergency evacuation modeling of the past and present
2. Evaluate the capability of the DYNASMART-P software
3. Create a DYNASMART-P model of the Wasatch Front region
4. Simulate a few cases of what might happen to traffic flow in a specific region of the Wasatch front
4. Enumerate possible cases that can be modeled by DYNASMART-P

3. List the major tasks required to accomplish the research objective(s): 1.5 yrs **Estimated person-hours:** 2,000 hrs

1. Conduct a literature search for recent developments in this research area
2. Evaluate the capability of the DYNASMART-P through its user manual and cases modeled by DYNASMART-P
3. Collect network characteristics data to create a DYNASMART-P model
4. Create a DYNASMART-P model of the Wasatch Front region consisting of arterials and collectors
5. Set up a design of experiment for evaluating earthquake damage scenarios
6. Simulate scenarios to evaluate how traffic might be assigned to undamaged links
7. Summarize possible traffic congestion/bottleneck situations that may hinder evacuation process and countermeasures
8. Prepare a final report including guidelines for implementation on enforcement resource allocation

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in July 2005 and end in December 2006

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University working with UDOT and MPO

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
A DYNASMAT-P model of the Wasatch Front & Training sessions for operating the models

8. Describe how will this project be implemented at UDOT.

Traffic Operations Center, Traffic Safety Division, UHP, Planning Division working together to plan for various emergency evacuation scenarios

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Natural disasters might strike the Wasatch Front region anytime. UDOT must be prepared for it. UDOT's plans for the 2002 SLC Winter Olympics were huge success. But the Games gave UDOT a long lead time and the venues are already fixed. In the aftermath of an earthquake, "venues" and people's move are more dynamic. This study will prepare a model for quickly simulate multiple cases.

10. Describe the expected risks, obstacles, and strategies to overcome these.
None, except collecting geometric, traffic, and control data of the network and O-D data. These can be arranged with UDOT and MPOs.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $60,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mitsuru Saito	BYU	422-6326	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: **MPOs, Governor's Office, City and County Mayor's offices**

RESEARCH PROBLEM STATEMENT

Problem Title: Pros and Cons of Toll and HOT Lane Facilities **No.: 05.05-8**

Submitted By: Grant Schultz (BYU) **E-mail:** gschultz@byu.edu

1. Briefly describe the problem to be addressed:

Over the past few years UDOT has initiated a statewide study to evaluate the potential for implementing various managed lane techniques including: 1) reversible lanes, 2) high occupancy vehicle (HOV) lanes, 3) high occupancy toll (HOT) lanes, 4) fast and intertwined regular (FAIR) lanes, and 5) toll facilities. The results of this study provided the background on managed lane technologies available for consideration in the state as well as some of the issues associated with the implementation of such lanes.

The purpose for this research project is to advance the concept of toll facilities in the state of Utah by comparing, contrasting, and identifying the pros and cons of regular toll lanes vs. high occupancy toll (HOT) lanes. This would include a summary and discussion of the impacts on traffic, expected revenue projections, and implementation details (i.e., what is required to manage each technique).

Strategic Goal: ☐ Preservation ☐ Operation ☒ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Prepare a summary of the state of the practice for toll and HOT lanes.
2. Prepare a summary of the pros and cons for toll vs. HOT lanes.
3. Identify the traffic impacts, revenue projections, and implementation details for toll and HOT lanes.

3. List the major tasks required to accomplish the research objective(s): 1 year Estimated person-hours 1,600

1. Literature review to identify the pros and cons of the toll facilities.
2. Survey state DOTs and research agencies that are currently using and managing toll and HOT lanes.
3. Summarize survey results.
4. Estimate revenue projections and summarize implementation details.
5. Prepare a summary of results (research document) as well as a presentation of these results for UDOT.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in August 2005 and end in August 2006.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
The deliverables expected from this project would include a report outlining the comparison of toll vs. HOT lanes and a presentation for UDOT staff summarizing the results.

8. Describe how this project will be implemented at UDOT.
This project will be implemented at UDOT through the planning program by providing information on toll and HOT lanes that can be utilized in corridor project evaluations.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
UDOT will benefit from this project as the groundwork will be set for planning and operations to consider toll and HOT lanes in future corridor projects.

10. Describe the expected risks, obstacles, and strategies to overcome these.
No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):$30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Grant Schultz	Brigham Young University	(801) 422-6332	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: WFRC, MAG.

RESEARCH PROBLEM STATEMENT

Problem Title: The Coordination of Roadway and Bridge Construction Projects **No.:** 05.05-9

1. Briefly describe the problem to be addressed:

The coordination of roadway and bridge construction projects at times seems serendipitous. This could result in wasted resources and have increased adverse effects on the traveling public and commerce.

Strategic Goal: ☐ Preservation** ☐ Operation** ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Identify similar time tables used by planners in roadway and bridge operations i.e. oil change philosophy

2. Identify ways to coordinate programs starting in the planning phase and continuing through completion of construction.

3. Using the STIP and LRP for source data, develop a process to identify and minimize conflicts. This may include using GIS technology to represent both funded and proposed projects. It might also help to identify areas of the LRP where maintenance could be shut off or minimized pending upcoming projects.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Establish a process by which the LRP and STIP could be graphically represented.

2. Make recommendations as to where responsibility for coordination of efforts should lie. i.e. asset managers get together with planners to establish where the biggest 'bang for the buck' can be obtained with the greatest amount of cooperation and the least amount of conflict. When it is all said and done, who gets the phone call when projects collide?

3. Make recommendations as to what current processes could be used collaboratively or possibly even combined. This includes efforts at the Region and Complex level

4. How will this project be implemented? (e.g. training, equipment, software, hardware, field demos, workshops, etc.)

☐ Improved asset ☐ Crashes reduced ☐ Environmental benefit ☐ Enhanced efficiency ☐ Other

This project may be implemented with additional in house software, training, and workshops.

(Please fill out other side of sheet as well.)

5. What deliverable(s) would you like to see? (e.g. useable technical product, technique, policy, procedure, specification, standard, software, training tool, etc.)

Develop a policy that mandates coordination of efforts.

Develop procedures to accomplish this coordination of effort.

6. Who in the Department could be the direct end-users of this study=s results?

Managers, planners, asset managers

7. How could the Department benefit from implementing the results of this study?

More confidence from the public and legislature. Better use of resources. Additional funding made available due to this increase in confidence.

8. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

9. List the potential champions (people interested in and/or willing to participate in the Technical Advisory Committee for this study):

Name	Organization/Division/Region	Phone	Attended UTRAC
A) Todd Jensen	Structures Division	957-8507	Yes
B) Dave Eixenberger	Structures Division	965-4191	Yes
C) Dan Adams	Structures Division	965-4813	Yes
D) Asset Managers			
E)Long Range Planners			
F) Region Planners			

10. Identify other Utah agencies or groups that may have an interest in supporting this study:

☐ City** ☐ County** ☐ MPO** ☐ Research Organization ☐ Private Industry** ☐ University ☐ Other

List names:

11. Identify other regional/national agencies or groups that may have an interest in supporting this study:

☐ FHWA** ☐ USGS ☐ EPA ☐ NCHRP ☐ TCRP ☐ State DOT=s** ☐ Other

List names:

RESEARCH PROBLEM STATEMENT

Problem Title: Durability of Waterborne Paint Pavement Markings **No.:** 05.06-1

Submitted By: Vincent Liu **E-mail:** vliu@utah.gov

1. Briefly describe the problem to be addressed:

Department uses waterborne paint on the most of the highway pavement markings. Pavement markings on many high traffic intersections will last about 3 months.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Search for more durable waterborne paint for high traffic areas

2. Search and recommend for other pavement marking materials

3.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours** 300

1. Field test – install four different types of waterborne paints on the four legs of an intersection. Each leg of the intersection should have a similar traffic volume. Maintenance Division will select an intersection for this research project.

2. Inspect and record retroreflectivity – inspect pavement marking, document, take pictures, and record retroreflectivity monthly.

3. Analyze data

4. Make recommendations

5.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Field test in June, 2005
Inspect and record data every other month
Analyze and make recommendations in June, 2006

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☒ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University or UDOT

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Recommended products

8. Describe how will this project be implemented at UDOT.

We could first implement by having an agency contract for in-house maintenance use.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Save on money, labor, and equipments – UDOT/State
Reduce work related risk – UDOT Staff
Increase safety – Public and UDOT

10. Describe the expected risks, obstacles, and strategies to overcome these.

Paint technology maybe an obstacle. Search for other pavement marking materials.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Vincent Liu

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): 300

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Vincent Liu	Central Maintenance 801-965-4077		
B)	Gary Lamoreaux	Cedar Dist. Paint Crew 435-590-0263		
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title:	Highway Advisory Radio – Evaluation, Standardization, & Innovation	No.:05.06-2
Submitted By:	Chris Siavrakas - TOC	E-mail: csiavrakas@utah.gov

1. Briefly describe the problem to be addressed:

Highway Advisory Radio is gaining new momentum as a tool to deliver complex information about Incidents, Special Events, and Construction information to the traveling public. As we look to expand the utilization of HAR, we need to understand how the future of Radio Communication is changing with technology. We also need a better understanding of the limitations of HAR, with current technology. One of the most difficult aspects of HAR is understanding its effectiveness. Without administering costly roadside polls, it is difficult to adequately summarize both quantitatively and qualitatively the user benefit of HAR.

Strategic Goal: ☐ Preservation ☒ Operation ☒ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Evaluate Current and Emerging Technology associated to HAR

2. Establish a cost/benefit ratio for portable and permanent HAR

3. Standard Guidelines for selecting location and display to the public

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Determine a cost/benefit ratio for both permanent and portable HAR applications 200

2. Present Radio band limitations/overlaps and new technologies (Satellite Radio, In-Vehicle radio break in) 160

3. Present best methods for alerting traffic to turn on HAR (sign/flasher design) 160

4. Review Web-based expansion that allows the HAR message to be heard from the internet 160

5. Prepare Draft and Final of Report – Publish ?????

6. Presentation Preparation & Presentation meeting 120

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Week 1-Identify Team members-delegate tasks – TAC Meeting
Week 2-5 - Preliminary Search and compilation of other programs lessons learned –TAC meeting
Week 6-8 – Begin specific tasks
Week 9 – TAC meeting –progress update/stearing check
Week 10-13 Complete Tasks
Week 14 – Final TAC meeting
Week 15-16 Publish Report
Week 17 – Present Deliverables/Findings to UDOT

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☒ Experimental Feature ☒ New Product Evaluation ☒ Tech Transfer Initiative ☐ Othe

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

-HAR Design Standard

-Training/Presentation Session

-HAR Planning and Operating Guideline (not a MANUAL)

8. Describe how will this project be implemented at UDOT.

As we seek to expand user information tools, we need an evaluation of current systems and future potential trends to provide like service.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will be able to better manage public resources to improve traffic flow quality for Incidents, Special Events, and Construction activities. Improving this feature directly effects the publics ability to make informed choices about their trip planning options.

10. Describe the expected risks, obstacles, and strategies to overcome these.

We may not be able to establish a confident cost-benefit ratio due to the strong variability of the audience. The ability of the audience to react correctly to a HAR message and to be able to measure their reaction will be challenging.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A)Chris Siavrakas-TOC		887-3620	
B) Sam Sherman -TOC		887-3744	
C) Bryan Chamberlain - TOC		887-3723	
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: Airports, Marinas, Parks

RESEARCH PROBLEM STATEMENT

Problem Title: Skid Index Trigger Values **No.:** 05.06-3

Submitted By: Lloyd R. Neeley **E-mail:** lneeley@utah.gov

1. Briefly describe the problem to be addressed:

UDOT currently has in place a guideline for which values of skid index are considered standard, marginal, or deficient. UDOT practice is for Program Development to notify the Regions when skid index values for a section of pavement become deficient, and to advise them to program a corrective treatment, and to post the section as "Slippery When Wet" until such time that a corrective treatment can be applied. Logically, however, some values of skid index present more of a hazard than others. The intent of this problem statement is to determine what value of skid index would require UDOT to take immediate corrective action, as opposed to merely placing a corrective treatment on the program.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Establish values of the skid index which would trigger immediate corrective action.

2. By functional classification, either reconfirm the existing values, or establish new values of skid index that should be considered as standard, marginal, or deficient.

3. Produce a report that explains the relationship between skid index and level of hazard in practical terms.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Review and summarize UDOT's original research used to establish the existing guideline.
2. Review and summarize measures used in other states to quantify skid resistance, reporting of those measures to interested parties, and trigger values for corrective action. Report on any differences between UDOT's measures and those used in other states.
3. Investigate and report on the relationship between UDOT's skid index and other material properties related to skidding such as the coefficient of friction.
4. Use UDOT accident data and skid data, for different functional classifications, to investigate statistical relationships between wet weather accidents and various values of skid index. Combine functional classifications as necessary to obtain statistically valid sample sets. Identify the most clear relationships, with emphasis on distinctions between levels of hazardous condition.
5. Recommend values of the skid index which should be considered standard, marginal, deficient, and seriously deficient (requiring immediate corrective action).
6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, in combination with UDOT staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- Report describing the original research used to establish UDOT's current guideline and practice, describing other states' practices, and describing the meaning of the skid index in both theoretical and practical terms.
- Report describing the current research effort, including data used, analysis methodology, and results and conclusions.
- Recommended UDOT policy and procedure on collection and use of skid data, and on indicated corrective measures for identified deficient pavements.

8. Describe how will this project be implemented at UDOT.

Based on the recommendations from the research, UDOT will establish a policy and procedure that outlines collection, data reduction, and reporting of skid index data, and establishes by functional classification which values of skid index should be considered standard, marginal, deficient, or seriously deficient, and what action(s) should be taken based upon those values.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Bill Lawrence

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Bill Lawrence	UDOT Program Development	965-4158	
A)	Lloyd Neeley	UDOT Central Maintenance	965-4789	
B)	Gary Kuhl	UDOT Program Development	964-4552	
C)	Nathan Lee	UDOT Region 1	(801)620-1606	
D)	Doug Anderson	UDOT Research	965-4377	
E)	Russ Scovil	UDOT Program Development	965-4097	
F)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA, UDOT Traffic and Safety, UDOT Risk Management

RESEARCH PROBLEM STATEMENT

Problem Title: Alternative Methods of Measuring Pavement Surface Conditions **No.: 05.06-4**

Submitted By: Ralph Patterson **E-mail: ralphpatterson@utah.gov**

1. Briefly describe the problem to be addressed:

UDOT is looking for alternative methods of measuring pavement surface conditions(i.e., moisture content, temperature and chemical etc…) to the current practice of using roadway pucks. These technologies/methodologies should be less intrusive to the road surface than the ones currently employed, while supplying the same level of information presently available.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop a non-intrusive method for detecting pavement temperatures and eutectic points of the road way surface.

2. Develop alternatives to measuring pavement temperature and chemical content other than using roadway pucks: The intent is to determine if there is a more maintainable, less expensive, and easier to install technology that will provide the information currently provided by the RWIS-ESS puck sensors.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Literature search/Vendor interviews (40 hours)

2. Existing product testing utilizing previous deployed RWIS sites (250 hours)

3. Enhancement or development of instrumentation to satisfy the above goals (960 hours)

4.Report (10pages) on findings and recommendations for deployment of said instrumentation (40 hours)

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Spring 2005 conduct literature search and vendor interviews
Summer 2005 Product/methodology development, purchase current technologies to be tested
Fall 2005 Test existing technologies, continued product/methodology development
Winter 05/06 Test products/methodologies
Spring 2006 generate report with findings and recommendations

5. Indicate type of research and / or development project this is: Combination of Evaluation and Development

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Useable instrument as well as a report on recommendations for alternative methodologies to current practice

8. Describe how will this project be implemented at UDOT.

This product/methodology will be integrated into the sensor array on existing RWIS sites

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Historically, when road rehab has been done in locations where surface pucks are located, the pucks are no longer useable and we have to install new ones. In addition we then cut into the new pavement (chip seal etc) to reinstall the pucks. A non intrusive device will let us keep the sensors longer, while leaving the integrity of the road surface intact. Both maintenance and construction will benefit from this change in procedure.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Data assimilation into the current architecture will be a challenge, since NTCIP standards for surface conditions are not fully developed

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Ralph Patterson

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $135,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mark Parry	ITS Traffic Management Division	887-3768	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Validating work zone queue-caused delays estimated by DELAY Enhanced v.2 software with field data and simulation and shockwave analysis techniques **No.:** 05.06-5

Submitted By: Michael Kaczorowski, & Prof. Mitsuru Saito

E-mail: MKACZOROWSKI@utah.gov, msaito@byu.edu

msaito@byu.edu

1. Briefly describe the problem to be addressed:

The BYU research team recently completed the DUCK program which estimates user costs caused by speed reduction through the work zone. One feature of DUCK provides the user hourly volume distribution data necessary to run the DELAY Enhanced v.2 software which estimates delays caused by queues. When DUCK determines that queue would be developing given the volume and capacity reduction, it recommends the user to use a method that will enable the user to estimate queue-caused delays. Queue-caused delays can be estimated by any software that has such a feature; however, UODT chose to use the DELAY Enhanced v.2 program at present because of its intuitive data entry features. (QUICKZONE produced by FHWA can substitute DELAY Enhanced v.2.) The DELAY Enhanced v.2 program is based on the so-called "conventional" queue estimation method based on deterministic queuing analysis. Deterministic queuing analysis tends to underestimate delays. Hence, it is recommended that a study be conducted to compare queue-caused delays estimated by the DELAY Enhanced v.2 software and the delays estimated by field data and simulation and shock wave analysis to enhance the reliability of the user cost estimation procedure developed by the previous study.

2. List the research objective(s) to be accomplished:

1. Compare queue-caused delays estimated by the DELAY Enhanced v.2 (deterministic queuing analysis) and by field data
2. Compare queue-caused delays estimated by the DELAY Enhanced v.2 and by simulation
3. Compare queue-caused delays estimated by the DELAY Enhanced v.2 and by shockwave analysis
4. Develop adjustment factors as intermediate measure to make corrections to delays estimated by the DELAY Enhanced v.2 program
5. List recommendations to improve the DELAY Enhanced v.2 program to reflect the findings of the study

3. List the major tasks required to accomplish the research objective(s): 1 year Estimated person-hours: 1,400 hrs

1. Conduct a literature search for state of the art delay estimation methods
2. Select at minimum two field study sites where work zones would create queues and where queues are observable by CCTV and demand to the sites can be monitored and the capacity of work zone can be measured.
3. Collect field data that will correlate the location to join a queue and travel time needed to eventually leave the queue in order to develop a relationship between queue position and delay time
4. Simulate the segment to estimate delays caused by the work zones
5. Conduct shockwave analysis (deterministic) to estimate queue-caused delays
6. Compare the delays estimated by the DELAY Enhanced v.2 software and the delays estimated by the other three methods mentioned in tasks 3, 4, and 5
7. Develop adjustment factors as intermediate measure to make corrections to delays estimated by the DELAY Enhanced v.2 method
8. Recommend improvement options to enhance the accuracy of delay estimation by the DELAY Enhanced v.2 program.
9. Write a final report

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in July 2005 and end in June 2006

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT

5. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Adjustment factors for delays estimated by the DELAY Enhanced v.2 and recommendations for improving the DELAY Enhanced v.2 software.

8. Describe how will this project be implemented at UDOT.

Prove adjustment factors to the users of the newly developed user cost estimation procedure. Can immediately be implemented after the work is done.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Improve UDOT's capability and accuracy for estimating user costs incurred by work zones.

10. Describe the expected risks, obstacles, and strategies to overcome these.
No risk expected.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Mike Kaczorowski	Planning Division, UDOT		
B) Mitsuru Saito	BYU 422-6326		
C)			
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: **Other state DOTs, FHWA?, trucking companies, MPOs**

RESEARCH PROBLEM STATEMENT

Problem Title:	**Utah Intersection Safety: Issues, Contributing Factors and Mitigations – Further Study**	**No.: 05.06-8**
Submitted By:	Wayne D. Cottrell	**E-mail:** wcottrell@eng.utah.edu

1. Briefly describe the problem to be addressed:

The Utah Department of Transportation has funded a project entitled "Utah Intersection Safety: Issues, Contributing Factors and Mitigations." The project is scheduled for completion in June 2005. Among the products of this research will be lists of intersections that have a large number of collisions, and high, cumulative crash severity scores. The 10 to 15 intersections with the largest numbers of crashes and highest scores are to be examined in some detail. Limited resources will prohibit examinations of additional intersections. A secondary effort is needed to investigate additional intersections, to obtain a clearer picture of the recurring factors, and to improve the development of intersection safety strategies. Further, intersection crash data tools in the Crash Data Delivery System were still under development during the aforementioned project. The new project would benefit from the availability of completed and refined data tools.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

The objective of this research would be to identify additional issues, factors and mitigating strategies associated with intersection safety, and to provide further inputs to the development of a statewide intersection safety plan.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours: 1,900**

1. Lengthen the statewide lists of high-crash intersections from 50 to 100.
2. Expand the UDOT-region lists of high-crash intersections from 25 to 50.
3. Consult new literature on intersection safety, especially works published since early 2005.
4. Examine an additional 15 to 20 high-crash intersections, supplementing the 10 to 15 examined in the June 2005 study.
5. Given that most, if not all, of the highest-crash intersections are signalized, develop a separate ranking and analysis of high-crash, unsignalized intersections.
6. Identify recurring issues and causal factors through the recognition of crash patterns at the "featured" intersections.
7. Using procedures and findings from the previous study, and from the literature, suggest mitigating strategies.
8. Prepare a report that summarizes the data, analysis and findings, and that suggests an example safety plan.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

9-12 month project envisioned; work plan would progress according to the tasks outlined above.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- A draft intersection safety plan containing examples of wide-level and localized improvement strategies, with each tied to certain crash patterns and causal factors.
- Procedures for recognizing and analyzing intersection safety problems.
- A report summarizing the crash data, data analysis, findings from the literature, and the preceding items

8. Describe how will this project be implemented at UDOT.

The near-term UDOT response to the findings of this project might be strongest at the regional level. Here, regional engineers might work toward improving the high-crash intersections identified by the research. Improvements recommended by the researchers might be considered by the engineers. The long-term response might be to develop a statewide intersection safety plan, based on the example mitigations in the final report, that will enable UDOT to have a proactive rather than reactive approach.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The results of this study could be treated as a draft, or template for, a statewide intersection safety plan. The Federal Highway Administration has assigned one of four high-priority levels to improving intersection safety. This research would contribute to Utah's role in meeting this high-priority federal objective. A number of interventions for improving intersection safety exist; some, such as red light cameras, have been met with controversy and resistance. This study may help to clarify the usefulness of certain strategies in improving intersection safety. As a result of this study, UDOT should be able to obtain a clearer picture of intersection safety needs, as well as the most effective and efficient strategies to implement.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Problems associated with the CDDS intersection tools are expected to be remedied in time for this project. Time and resources may limit the amount of in-the-field investigations that can be performed. Recommended mitigations may not be effective in modifying driver behavioral issues.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Robert Hull (Traffic and Safety Division); Robert Clayton (Traffic and Safety Division)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

$45,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Mack Christensen	UDOT Region 2		
B) Doug Anderson	UDOT Research		
C) Chris Glazier	UDOT Region 2		
D) David Kinnecom	UDOT ITS & Operations		
E) Amy Lightfoot	Utah Dept. of Public Safety		
F) Rukshana Lindsey	UDOT Research		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: FHWA, FMCSA, NHTSA, WFRC, Cities (Salt Lake City, Taylorsville, West Valley City, etc.)

RESEARCH PROBLEM STATEMENT

Problem Title: Electronic License Plate Recognition System Testing **No.:** 05.06-9

Submitted By: Wayne D. Cottrell **E-mail:** wcottrel@eng.utah.edu

1. Briefly describe the problem to be addressed:

License plate recognition (LPR) systems are becoming increasingly popular as a means of securing limited-access areas, patrolling borders, locating vehicles and insurgents, and traffic management. A problem is that traditional LPR systems depend on the accuracy and precision of the reading. These can be influenced by sunlight, plate cleanliness, damage to the plate, odd lettering sizes or patterns, and other factors. Some LPR systems have an accuracy of no greater than 50%. A technology similar to that used for electronic toll collection systems has been proposed for LPR. In this, a transponder is attached to a license plate. Radio frequency identification and detection technology is used to transmis information about the vehicle and registration to a roadside reader. Since the information transmittal does not depend on the visibility of the license plate, these "e-plate" systems have the potential to be far more accurate than traditional LPR systems.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

The objective of this research would be to install and test an electronic LPR system. The testing would be done on a group of three test vehicles, under a range of vehicle speeds, headways, and lighting conditions. The project is being proposed to the Transportation Research Board's IDEA program, with a request for funding of about $125,000. The purpose of UDOT support would be to supplement the IDEA funding. Such support would strengthen the proposal through the inclusion of a cooperative feature with an established State transportation institution.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours: 1,500**

1. Perform a literature review of license plate recognition, including traditional and electronic systems.
2. Acquire electronic license plate-related equipment from vendor; obtain materials and equipment needed for testing (motor vehicles, communications accessories, computer, etc.).
3. Develop and produce electronic license plate prototypes, for use in testing.
4. Identify, select, confirm and equip test sites (a preliminary investigation has identified the Rocky Mountain Raceway as a potential test site).
5. Outfit vehicles, set up and install equipment, "train" drivers, and perform pre-test checks.
6. Conduct daytime and nighttime testing over a period of five days.
7. Compile and analyze data, using up to five different performance criteria.
8. Prepare and submit a final report.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

6-month estimated timeframe; work would proceed according to the tasks outlined above.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☒ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, Consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A final report that summarizes the data from the test runs, evaluates the accuracy and effectiveness of the e-plates technology, and makes recommendations for future testing or applications.

8. Describe how will this project be implemented at UDOT.

This project would be funded, primarily, by the Transportation Research Board's IDEA program. UDOT's involvement would be through a financial contribution to the research – the UDOT funding would cover the costs of renting the test site. UDOT might also have some involvement in the actual tests.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This research would help to advance the state of the technology used to recognize license plates and motor vehicle registrations. The RFID technology has been used at several U.S.-Canada border crossings and at a military facility in Massachusetts, but has not been widely deployed. UDOT participation in this project would help to ensure that the e-plates technology is rigorously tested in a controlled environment. Also, UDOT would be recognized as a facilitator in the advancement of our transportation security capabilities.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Potential radio frequency compatibility problems are anticipated. Weather conditions during the tests (rain, high winds) could affect the outcomes. Test drivers may need special training to fulfill test parameters. A 5-day test period that allows for problems with setup, training and conditions should be mitigating.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): David Kinnecom (ITS & Operations)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $5,000 (+ ~$125,000 in IDEA funding)

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Robert Hull	UDOT Traffic and Safety		
B) Chad Sheppick	UDOT Motor Carriers		
C) Ron Butler	UDOT Motor Carriers		
D) Chris Glazier	UDOT Region 2		
E) Rukshana Lindsey	UDOT Research		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: FMCSA; TSA; Dept. of Homeland Security; FHWA

RESEARCH PROBLEM STATEMENT

Problem Title: Evaluation of and Potential for Improvements to Bicycling Safety in Utah **No.:** 05.06-10

Submitted By: Wayne D. Cottrell **E-mail:** wcottrel@eng.utah.edu

1. Briefly describe the problem to be addressed:

Bicycle-motor vehicle collisions, though not as common as pedestrian-vehicle collisions, recur with great enough frequency to regularly receive a significant amount of media attention in Utah. Incidents that result in injuries or fatalities, in particular, can be widely publicized, and are certainly devastating to those involved. Proposed statewide legislation would require motorists to pass all bicyclists with at least a 3-ft buffer. While this legislation might generate a greater number of citations against motorists who are involved in incidents with bicyclists, there is no guarantee that bicycling safety would be improved. There is a need to examine bicycling safety issues and problems to develop an improved understanding of the countermeasures.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

The objective of this research would be to develop a clearer understanding of bicycling safety issues, through an examination of bicycle-motor vehicle crash data, the bicycling safety literature, and bicycling safety programs and countermeasures. One product of this research would be a set of bicycle safety improvement strategies that might be considered for implementation.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours: 1,100**

1. Examine bicycle-motor vehicle collision data from Utah's Crash Data Delivery System.
2. Identify high-crash locations and recurring collision "themes."
3. Review the literature on bicycling safety.
4. Review existing bicycling legislation and safety-related programs in Utah.
5. Review bicycling legislation and safety-related programs in other States.
6. Develop a plan or strategy for improving bicycling safety in Utah, using the results of a crash data analysis, and evaluations of program and countermeasure effectiveness.
7. Discuss ways in which the plan or strategy could be implemented.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

9-month project envisioned; work would progress according to the tasks outlined above.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- Bicycle-motor vehicle crash data summaries and analysis.
- Procedures for relating bicycle-motor vehicle collisions to countermeasures and programs.
- A report summarizing the preceding items, the results of the literature and state-of-the-practice reviews, and a plan or strategy for improving bicycling safety.
- A discussion paper or report section suggesting ways in which the report's plans and strategies can be implemented.

8. Describe how will this project be implemented at UDOT.

Implementation might, initially, revolve around communication and dissemination. This could be accomplished through a series of workshops and meetings with interested agencies. Incorporation of the findings and recommendations into the State bicycle and pedestrian plan would be another step toward implementation. The research would, most likely, identify specific issues that would warrant additional study. For example, legislation requiring the usage of bicycle helmets might be an example mitigation; further study would be needed, however, to estimate the legislation's potential effectiveness.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This research would help UDOT better understand the issues and concerns associated with bicycling safety in Utah. The research would also improve the understanding of bicycling safety programs and countermeasures, including those currently existing in Utah, and those in use elsewhere. The implementation of the research findings may lead to the development of a statewide bicycling safety plan. The eventual benefit may be measured in terms of a reduction in the number of bicycle-motor vehicle collisions in Utah. These results could lead to favorable health and lifestyle impacts.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Bicycle-motor vehicle crash data might not be detailed enough to fully isolate the contributing factors. Mitigations that involve construction, such as new bike lanes and paths, may prove to be costly. Certain strategies, such as bicycle helmet laws, may be met with some resistance.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Sharon Briggs (Program Development)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Robert Hull	UDOT Traffic and Safety		
B) Robert Clayton	UDOT Traffic and Safety		
C) Dan Bergenthal	Salt Lake City		
D) John Quick	UDOT Transportation Planning		
E) Amy Lightfoot	Utah Dept. of Public Safety		
F) Ken Berg	UDOT Research		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: FHWA, NHTSA, WFRC, MAG, Cache MPO

RESEARCH PROBLEM STATEMENT

Problem Title: Impacts of Preemption on Signalized Intersections **No.: 05.06-11**

Submitted By: Mark Taylor & Mark Parry **E-mail:** Marktaylor@utah.gov
Moparry@utah.gov

1. Briefly describe the problem to be addressed:

Emergency pre-emption of traffic signals disrupts the coordination and timing. The purpose of pre-emption is to decrease response times for emergency vehicles and increase safety while traveling to incidents.

What are the impacts of emergency vehicle preemption on traffic flow in terms of delay, increased driver frustration, and safety of the vehicle phases, including pedestrians. Quantify the benefits of preempting traffic signal timing for emergency/law enforcement vehicles. Identify the number of illegal or unwarranted preemption occurrences. The research could provide recommendations on how to limit illegal use through special coding features offered by the manufacturers and suggest design criteria on locations to install preemption.

2. List the research objective(s) to be accomplished:

1. Impacts of emergency vehicle preemption on traffic flow in terms of delay and accidents for the vehicles.
2. Qualitatively discuss the benefits to emergency vehicles.
3. The effects of emergency vehicle preemption on pedestrian phases (movements) and recommendations for pedestrian clearance timings.
4. Recommendations to handle violations and control of emergency vehicle preemption.
5. Recommendations for the recovery time of coordination and the preemption settings for signal timing.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours 500**

1. Perform literature search of procedures/recommendation for emergency vehicle preemption installations (design criteria). Give UDOT suggestions.
2. Site selection and data collection at intersections where emergency vehicle preemption occurs regularly.
3. Develop the modeling work
4. Address/research how multi agencies can use preemption devices and coding of vehicles (interoperability).
5. Investigate how preemption information can be transferred to central control automatically.
6. Quantify the effects on pedestrians and give recommendations to UDOT on preempting pedestrians (i.e. cutting short the ped clear phase)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

No time line.

5. Indicate type of research and / or development project this is:

Large: x **Research Project** ☐ **Development Project**
Small: ☐ **Research Evaluation** ☐ **Experimental Feature** ☐ **New Product Evaluation** ☐ **Tech Transfer Initiative** :
☐ **Other** _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University or consultant

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7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Design method, manual of practice, policy & procedures

8. Describe how will this project be implemented at UDOT.

Guidelines can be created from the recommendations made a state standard by the Traffic Engineering Panel. Policies can be implemented for all UDOT regions. Guidelines will be implemented with all new installations of Pre-emption devices.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit by having clear direction where to install preemption. In addition, consistency will be achieved through all UDOT regions and possibly other jurisdictions (city and county). Limit the abuse of preemption. The LOS of intersections may improve without preemption abuse. The TOC and DPS will be notified quicker of vehicles in emergency pursuit and estimated time of arrival. The overall safety of the signal operation can improve, especially relating to pedestrian crossings.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Priority technology may limit the system wide implementation of any operational improvements. Obtaining agency cooperation for the study.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Mark Taylor

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study: Mark Parry

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mark Taylor	UDOT TOC	887-3714	Yes
B)	Deryl Mayhew	UDOT TOC	887-3605	Yes
C)	Degen Lewis	UDOT Region 3	222-3401	Yes
D)	David Kinnecom	UDOT TOC	887-3707	Yes
E)	Adam Lough	Orem City	229-7502	No
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Provo City public works; Orem city public works. Salt Lake City traffic. Various regional fire departments.

RESEARCH PROBLEM STATEMENT

Problem Title: Time factor in the analysis of work zone related crashes No.: 05.06-12

Submitted By: Prof. Mitsuru Saito E-mail: **msaito@byu.edu**

1. Briefly describe the problem to be addressed:

Crash analysis is often done to estimate general crash rates for a facility. When crashes are related to work zones (directly or indirectly) the time factor in crash occurrence can be an important consideration for effectively allocating resources for crash prevention including law enforcement deployment. No work has been done on the effect of time factor on crash occurrence. Do work zone related crashes happen more when traffic control devices are laid out, or right after the work has started, or in the midst of work periods? For a long-term work zone, drivers may be conditioned to be cautious and for a short-term work zone, they do not have much time to get conditioned. Knowing the relationship between the time factor of work zone crashes and accident occurrence will help UDOT and contractors to effectively allocate their traffic control budgets. Hence, it is proposed that data mining of accident data be conducted and the relationship between their occurrence times and work zone activity schedules be studied to evaluate the relationship between time of crash occurrence and work zone schedules.

2. List the research objective(s) to be accomplished:

1. Find relationship between work zone activity schedules and crash occurrence times
2. Find relationship between work zone types and crash occurrence times
3. Develop guidelines for crash prevention resource allocation for work zones

3. List the major tasks required to accomplish the research objective(s): **1 year** Estimated person-hours: **1,200 hrs**

1. Conduct a literature search for recent studies on work zone and accident occurrence
2. Select segments of highways for analysis
3. Data mine accident records for the segments selected
4. Collect work zone schedules of the past for the study segments
5. Conduct statistical analysis about timing and location of accidents
6. Evaluate temporal trends of accident occurrence
7. Develop guidelines for enhanced resource allocation for accident prevention
7. Prepare a final report

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in July 2005 and end in June 2006

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

5. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training,

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Analysis report, guidelines and policies for accident prevention resources based on the results of the analysis; workshop

8. Describe how will this project be implemented at UDOT.

Through guidelines and workshops

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

More effective allocation of resources for accident prevention related to work zone activities (This also applies to contractors.)

10. Describe the expected risks, obstacles, and strategies to overcome these.

None, because there will be no field equipment installations. This study focuses on crash data mining.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mitsuru Saito	BYU 422-6326	422-6326	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: **DOTs**

RESEARCH PROBLEM STATEMENT

Problem Title: Evaluate the accuracy of truck traffic data and develop a truck traffic demand modeling procedure No.: 05.06-13

Submitted By: Prof. Mitsuru Saito E-mail: msaito@byu.edu

1. Briefly describe the problem to be addressed:

As the BYU research team worked on the development of user cost estimation procedures, it was found that UDOT's truck traffic data may not be as accurate as they wished. Truck traffic significantly alters the amount of user costs incurred by delays caused by work zones. Truck traffic is important for other transportation studies; it plays an important role in many other transportation related studies including transportation planning, operational analysis, and pavement and bridge design. At planning level, movements of trucks on the state highway system will help UDOT properly allocate funds; at operational level, truck traffic is essential for evaluating the level of service of transportation facilities; at design level truck traffic is a main factor for designing pavement structure and bridge super and substructures. Therefore it is essential that UDOT has good grip on the accuracy level of truck traffic data they produce. Currently UDOT provides truck percentages but the accuracy level of truck data is unknown. This proposed study will first evaluate the level of confidence of current truck traffic data by a statistical sampling procedure and develop a procedure for modeling truck traffic demand.

2. List the research objective(s) to be accomplished:

1. Prepare a summary of state-of-the-art and practice of truck traffic accuracy estimation
2. Prepare a summary of state- of-the-art and practice of truck traffic demand modeling
3. Determine the confidence level and interval of current truck traffic data
4. Prepare a procedure to adjust truck traffic data obtained by the currently used data collection method
5. Develop a procedure for modeling truck traffic demand

3. List the major tasks required to accomplish the research objective(s): 1 year Estimated person-hours: 1,400 hrs

1. Conduct a literature search for recent developments in truck traffic accuracy evaluation method and truck demand estimation procedures
2. Survey state DOTs for their truck traffic estimation procedures
3. Conduct a structured sampling of permanent traffic count stations for a statistical analysis and collect traffic data at sampled count stations
4. Conduct a statistical analysis on the accuracy level of truck traffic data
5. Collect truck trip generation and distribution data internal and external to Utah (This state has only a limited truck entry points such as I-80, I-170, I-15, I-84, US40, etc.)
6. Create a truck traffic distribution map
7. Develop a procedure to estimate traffic flow in Utah's highway network
8. Prepare a final report including guidelines for considering confidence level and interval for using truck traffic

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in July 2005 and end in June 2006

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

5. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A procedure to estimate accuracy level of truck traffic; A model o estimate truck traffic on Utah's highways.

8. Describe how will this project be implemented at UDOT.

By providing procedures to improve the accuracy of truck traffic data

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

They will make the planning, operation and design work of UDOT more reliable in terms of truck traffic data. User cost estimation will be more accurate, operational evaluation will become more realistic, and pavement design will prove to be more cost effective.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No risk expected.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mitsuru Saito	BYU	422-6326	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: **Other state DOTs, FHWA?, trucking companies, MPOs**

RESEARCH PROBLEM STATEMENT

Problem Title: Creating an Emergency Evacuation Scenario Evaluation Tool for the Wasatch Front region **No.:** 05.06-14

Submitted By: Prof. Mitsuru Saito **E-mail:** msaito@byu.edu

1. Briefly describe the problem to be addressed:

The Indian Ocean earthquake of magnitude 9.0 stunned the world by tsunami tidal waves killing more than 150,000 people in Asian and African countries surrounding the ocean. A BYU geology professor predicted a serious earthquake several years ago in the earthquake stricken area to the government of Indonesia. The same professor predicts that an earthquake of magnitude of 7.0 would hit the Wasatch Front anytime. The Wasatch Front region is surrounded by mountains and the main artery that is the backbone is only interstate 15. When an earthquake hits the region, it is anticipated that I-15 will suffer serious damages and most likely damages bridges make I-15 impassable. How should UDOT prepare for this natural disaster? Though the dynamics of natural disaster makes it difficult to estimate what might happen, UDOT can simulate various levels and extent of damages of the highway infrastructure and prepare for such cases. In order to simulate such dynamic transportation situation, it is necessary that simulation models be equipped with a dynamic traffic assignment feature. FHWA has recently completed such planning level mesoscopic simulation model DYNASMART-P and the program is now available to simulate various what-if situations. Once a model of the region is created, it can be used for other situations such as traffic routing programs for large people gathering activities like football games and festivals.

2. List the research objective(s) to be accomplished:

1. Literature search for emergency evacuation modeling of the past and present
2. Evaluate the capability of the DYNASMART-P software
3. Create a DYNASMART-P model of the Wasatch Front region
4. Simulate a few cases of what might happen to traffic flow in a specific region of the Wasatch front
4. Enumerate possible cases that can be modeled by DYNASMART-P

3. List the major tasks required to accomplish the research objective(s): 1.5 yrs Estimated person-hours: 2,000 hrs

1. Conduct a literature search for recent developments in this research area
2. Evaluate the capability of the DYNASMART-P through its user manual and cases modeled by DYNASMART-P
3. Collect network characteristics data to create a DYNASMART-P model
4. Create a DYNASMART-P model of the Wasatch Front region consisting of arterials and collectors
5. Set up a design of experiment for evaluating earthquake damage scenarios
6. Simulate scenarios to evaluate how traffic might be assigned to undamaged links
7. Summarize possible traffic congestion/bottleneck situations that may hinder evacuation process and countermeasures
8. Prepare a final report including guidelines for implementation on enforcement resource allocation

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in July 2005 and end in December 2006

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University working with UDOT and MPO

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
A DYNASMAT-P model of the Wasatch Front & Training sessions for operating the models

8. Describe how will this project be implemented at UDOT.

Traffic Operations Center, Traffic Safety Division, UHP, Planning Division working together to plan for various emergency evacuation scenarios

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Natural disasters might strike the Wasatch Front region anytime. UDOT must be prepared for it. UDOT's plans for the 2002 SLC Winter Olympics were huge success. But the Games gave UDOT a long lead time and the venues are already fixed. In the aftermath of an earthquake, "venues" and people's move are more dynamic. This study will prepare a model for quickly simulate multiple cases.

10. Describe the expected risks, obstacles, and strategies to overcome these.
None, except collecting geometric, traffic, and control data of the network and O-D data. These can be arranged with UDOT and MPOs.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $60,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mitsuru Saito	BYU	422-6326	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: MPOs, Governor's Office, City and County Mayor's offices

RESEARCH PROBLEM STATEMENT

Problem Title: Evaluate effects of changes in law enforcement practices on freeway efficiency and safety No.: 05.06-15

Submitted By: Prof. Mitsuru Saito E-mail: msaito@byu.edu

1. Briefly describe the problem to be addressed:

A significant amount of resources has been devoted to enforcing freeway speed limits by the Utah Highway Patrol. However, speeding continues to be a problem. There are other driver behaviors that affect freeway performance and safety, including lane use, lane change, and car following disciplines. There are many violations of these disciplines on Utah freeways. Such violations contribute not only to decreased safety but also to inferior traffic flows. Many studies suggested that the motorists would choose whatever the speeds they believe to be safe given geometric and traffic conditions on freeways without regard to posted speed limits unless police officers are present. Freeways have superior design standards; hence the existing geometric conditions most likely give an impression to the speeding motorists that traveling a little faster than speed limits is considered by many to be still safe. If that is the case, reallocating traffic enforcement resources to enforce other driving disciplines may prove to be beneficial to improve safety. There is a need to study the effects of diverting some of the resources to enforcing other-than-speed-limit regulations on the overall safety on freeways and traffic flow.

2. List the research objective(s) to be accomplished:

1. Evaluate changes in freeway performance measures (such as speed distribution, density distribution, frequency of slow downs, accident experience) before and after the reallocation of law enforcement practices (between speed limit enforcement only and a combination of speed limit enforcement and other regulations (lane use discipline, lane change signaling, and car following)
2. Evaluate changes in user costs before and after of the reallocation of law enforcement practices
3. Conduct an opinion survey about the awareness of lane use, lane change and car following disciplines
4. Develop a guideline for law enforcement resource allocation for improved freeway efficiency and safety

3. List the major tasks required to accomplish the research objective(s): 1 year Estimated person-hours 1,400 hrs

1. Conduct a literature search for recent developments in this research area
2. Find current resource allocation levels by the Utah Highway Patrol and UDOT to speed limit enforcement
3. Identify data collection capabilities of the Traffic Operations Center and need for extra data collection equipment
4. Identify a segment of a freeway for field experiment
5. Set up a design of experiment for evaluate the impact of new traffic enforcement resource allocation
6. Conduct an opinion survey about the awareness of lane use, lane change and car following disciplines
6. Collect “before” data on speed distribution, density distribution, and user costs with current speed enforcement resource allocation
7. Design public relation programs to advertise the new enforcement strategy that will take place in the study area
8. Coordinate among agencies for the field data collection
9. Collect “after” data on the measures of effectiveness listed in Task 6 with a new enforcement resource allocation
10. Conduct statistical analyses on safety, traffic flow, and user costs
11. Prepare a final report including guidelines for implementation on enforcement resource allocation

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in July 2005 and end in June 2006

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A set of guidelines on traffic law enforcement resource allocation

Informational sessions for highway patrol officers and UDOT personnel in charge of freeway operation and traffic safety

8. Describe how will this project be implemented at UDOT.

A new traffic sign, PR, cooperation from UHP

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Better use of the median lanes resulting in efficient use of the available capacity, improved traffic safety, improved traffic flow, better traffic condition for emergency vehicles such as ambulances, fire engines, and police officers

10. Describe the expected risks, obstacles, and strategies to overcome these.

Traffic flow characteristics data need to be collected at every 0.5 mile. Need to find a segment of freeway that meets data collection requirements. UHP's cooperation is essential. By including UHP representatives in TAC, their assistance can be obtained.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mitsuru Saito	BYU	422-6326	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: UHP

RESEARCH PROBLEM STATEMENT

Problem Title: Development of a ramp metering algorithm for freeways in the Wasatch Front: Phase 1. Development of a conceptual framework for incorporating shockwave propagation characteristics in ramp metering algorithms

No.: 05.06-16

Submitted By: Prof. Mitsuru Saito

E-mail: 422-6326

1. Briefly describe the problem to be addressed:

Freeway congestion continues to be a serious problem for freeways in the Wasatch Front. The PI of this proposed study has worked on numerous traffic engineering/operation studies including an evaluation of ramp metering algorithms applied to a segment of I-15. He has found that the majority of the algorithms available today do not explicitly incorporate local bottleneck and shockwave propagation characteristics (creating dynamic moving bottlenecks moving upstream) and he considers that a lack of this feature may be a reason why a ramp metering algorithm that works in one freeway system may not properly work in another system. There are many hidden bottlenecks on the freeway and once a queue is formed the queue may move up as an upstream traveling bottleneck depending on the dynamic nature of demand-supply relation existing on freeways. Hence it is essential to locate hidden bottlenecks and how queues form and dissipate at such locations and their upstream segments of the freeway and this element of freeway traffic flow characteristics need to be incorporated into a ramp metering algorithm that is meant for the freeways in the Wasatch Front.

2. List the research objective(s) to be accomplished:

1. Select and analyze a study segment of I-15 for hidden bottlenecks (Suggested segment: between Point-of-the-Mountain and Provo because by selecting this stretch UDOT can find out why chronic congestion takes place in American Fork and Lehi area without any notable incidents in the area)
2. Study queue forming and dissipating characteristics in the study segment to identify factors that may be most effectively used in ramp metering algorithm
3. Develop a conceptual framework for incorporating explicitly shockwave development characteristics in a ramp metering algorithm that is specifically for the study segment

3. List the major tasks required to accomplish the research objective(s): 1 yr Estimated person-hours: 1,400 hrs

1. Conduct a literature search for coordinated ramp metering algorithms for new developments in this area
2. Select a study segment of I-15 (Suggested segment: between Point-of-the-Mountain and Provo because by selecting this stretch UDOT can find out why chronic congestion takes place in American Fork and Lehi area without any notable incidents in the area)
3. Conduct an in-depth capacity analysis of the study segment to analytically find hidden bottlenecks, including off-ramp intersections
4. Conduct field observations during AM and PM peak periods to determine analytically found bottleneck locations match the field
5. Develop a procedure (if necessary) to mitigating the differences between the analytical results and the field
6. Conduct shockwave analysis using analytical and simulation methods to learn how shockwaves propagate upstream
7. Develop a conceptual framework for developing a ramp metering algorithm that specifically incorporate shockwave propagation characteristics
8. Write a final report, suggesting the steps for the second phase of the project – Developing a tailor-made ramp metering algorithm for the study segment

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in July 2005 and end in June 2006

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Analytical, empirical, and simulation methods of locating hidden bottlenecks and shockwave propagation characteristics that can be used for training UDOT traffic engineers

2. A conceptual framework for developing a ramp metering algorithm for a particular segment of freeways (a tailor-made ramp metering algorithm) that incorporate shockwave propagation characteristics

8. Describe how will this project be implemented at UDOT.

The results of this study becomes a basis for developing a new ramp metering algorithm for freeways in the Wasatch Front.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Ramp metering algorithms that are most effective to the freeway system in the Wasatch Front will be developed and they improve the traffic flow on Utah's freeways

10. Describe the expected risks, obstacles, and strategies to overcome these.

Data collections require support from the Traffic and Safety Division.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mitsuru Saito	BYU	422-6326	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: DOTs, FHWA

RESEARCH PROBLEM STATEMENT

Problem Title: Development of a ramp metering algorithm for freeways in the Wasatch Front: Phase 2. Development of a ramp metering algorithm and evaluate its performance by simulation

No.: 05.06-17

Submitted By: Prof. Mitsuru Saito

E-mail: msaito@byu.edu

1. Briefly describe the problem to be addressed:

In Phase I of this research development of a conceptual framework for incorporating shockwave propagation characteristics into a ramp metering algorithm was proposed. This second phase of the proposed research builds upon the results of Phase I and develops a new ramp metering algorithm for the study section selected. Then, its performance will be evaluated using simulation. When the results of simulation analysis are found beneficial to the study segment and if ramp metering facilities are in place in the study area by the time the algorithm has been evaluated, a field experiment will be recommended. Even though a field experiment does not take place, a procedure for designing a ramp metering algorithm for other segments of freeways in the Wasatch Front will be developed.

2. List the research objective(s) to be accomplished:

1. Develop a ramp metering algorithm that incorporate shockwave propagation characteristics for the study site
2. Create a simulation model to evaluate the ramp metering algorithm developed
3. Conduct simulation analyses to evaluate the efficacy of the proposed ramp metering algorithm
4. Develop a procedure to develop a tailor-made ramp metering algorithm for other segments of freeways in the Wasatch Front
5. Conduct a field experiment of the proposed ramp metering algorithm in the study segment, if ramp metering facilities become available (Note that the researcher is considering using a stretch of I-15 between Point of the Mountain and Provo where shockwave propagation is creating dynamic bottlenecks in the stretch

3. List the major tasks required to accomplish the research objective(s): 1.5 yrs Estimated person-hours 1,600

1. Develop a mathematical model for the ramp metering framework developed in Phase I of this research
2. Create a program interface between the simulation model created in Phase I and the ramp metering algorithm modeled in Task 1
3. Set up a design of experiment to evaluate the performance of algorithm throughout morning and evening peak periods
4. Using freeway demand information collected in Phase I, simulate various cases according to the design of experiment set up in Task 3
5. Conduct a statistical evaluation of the efficacy of the algorithm using a selected set of measures of effectiveness
6. Develop a procedure to design a ramp metering algorithm to other parts of freeway segments in the Wasatch Front
7. Write a final report

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Begin in July 1, 2006 and end in December 2007

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

New ramp metering algorithm specifically developed for the studied section and its program that will interface a simulation software and guidelines for ramp metering methods

8. Describe how will this project be implemented at UDOT.

The procedure developed will be experimented to study other segments of the freeways in Utah where ramp metering facilities already exist. If it is determined to work as expected, they it will replace the current ramp metering program.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will be able to reduce freeway congestion and save user costs.

10. Describe the expected risks, obstacles, and strategies to overcome these.

There is no risk associated with this study. There is no field experiments involved in this study.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $50,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Mitsuru Saito	BYU	422-6326	
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: Other state DOTs, FHWA

RESEARCH PROBLEM STATEMENT

Problem Title: Determination of Crash Costs for Use in Benefit/Cost Analysis **No.: 05.6-18**

Submitted By: Jim McMinimee and Doug Anderson **E-mail:**

1. Briefly describe the problem to be addressed:

The available information that is used to estimate benefit/cost for transportation related improvements should be reviewed. Very high estimates of crash costs have been used in the past. This appears to be a case where societal estimates are being used for analytical purposes.

Benefit/cost estimates for pavement management, bridge replacements, traffic congestion mitigation, and other transportation improvements need to be appropriate and comparible.

2. List the research objective(s) to be accomplished:

1. Review national studies performed on the subject.
2. Identify other states practices.
3. Make recommendations.
4. Create policy.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
A report documenting recommended values. The report will recommend policy for use UDOT employees.

8. Describe how will this project be implemented at UDOT.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Jim McMinimee

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)				
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Biotechnical Stabilization and the use of Phreatophytes No.: 05.07-1

Submitted By: LA Heppler E-mail: lheppler@utah.gov

1. Briefly describe the problem to be addressed:

What are the long-term effects to Slope Stability Factor of Safety with the use of Phreatophytes? What is the impact to the material characteristics? What is the impact to pore pressure? What is the impact of root reinforcement?

Strategic Goal: ☒ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Measure the effects of planting Phreatophytes on poor soil sites such as slumps and landslides.
2.
3.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Access laboratory mud tanks - Define variables, define constants (40 hrs)
2. Create a poor quality of soil in a lab mud tank, divide tank into 2 sections. Run lab tests on material properties (40hrs)
3. Plant one section of the tank with a phreatophytes such as Coyote willows and leave the other half with no vegetation (20 hrs)
4. Let grow (provide acceleration-grow lights, fertilizer) (6 months – manpower would only be 1 hour per week - 30 hrs)
5. Tilt tank and document soil characteristics when failure occurs on both cases. Run lab tests on failed material (40hrs)
6. Compile data and write report. (80hrs)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

As plants need time to grow…the time frame is not critical. Total time frame 1year…actual research hours 250 hours.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☒ Research Evaluation Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐

Other_____

7. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

USU already has mud tanks and student work forces

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.) A proven recommendation that planting phreatophytes in problem soils is worth the cost. Estimated strength gain by using this technology. Estimated cost savings.

8. Describe how will this project be implemented at UDOT. New construction and retrofit existing problem areas. Results presentation to UDOT Maintenance personnel.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be. Reduce routine maintenance of some cut slopes and possibly save UDOT the cost of an expensive landslide repair.

10. Describe the expected risks, obstacles, and strategies to overcome these. Doesn't increase the cohesion and phi of the soil. Future studies could include which specific phreatophytes work the best in the different specific UT soil types.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): LA Heppler

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): 250hrs X $45 = $12,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Leslie Heppler	Geotechnical Division – Complex	965-4318	Yes
B) Keith Brown	Geotechnical Division – Complex	965-4234	Yes
C) Grant Gummow	Geotechnical Division – Complex	965-4307	Yes
D) Blaine Leonard	Research – Complex	965-4115	Yes
E) Francis Ashland	UGS-DNR	537-3380	Yes
F) Ira Bickford	Maintenance - Complex	965-4119	Yes
G) Lars Anderson	Environmental Manager R-2	887-3470	Yes

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:
Idaho DOT has expressed interest in the past

RESEARCH PROBLEM STATEMENT

Problem Title: Analysis of Field Data Relating Large Strain Dynamic Properties with Small Strain Dynamic Properties of a Pile Group **No.: 05.07-4**

Submitted By: Marv Halling, USU; Kyle Rollins, BYU **E-mail: halling@cc.usu.edu, rollinsk@byu.edu**

1. Briefly describe the problem to be addressed:

Significant uncertainty still exists in defining the dynamic stiffness and damping relationships for pile groups. Most tests are performed under static conditions and likely under-predict dynamic resistance. Eccentric mass shaking tests usually only give dynamic properties at small-strain levels, while behavior at both small- and large-strain is desirable in design. Many methods are based on small-strain tests and designers need to know how to account for differences at large-strain. During a recent NSF study, vibration measurements were made on two full-scale pile groups using the USU eccentric mass shakers after each application of static loading with a hydraulic ram and dynamic loading with a statnamic sled. Analysis of these measurements will provide stiffness and damping values at small strain for which limited data is presently available. Comparisons can also be made with properties obtained from static and statnamic load tests to help designers extrapolate to large-strain behavior.

2. List the research objective(s) to be accomplished:

1. Define dynamic stiffness and damping values for full-scale pile groups.
2. Evaluate difference between low-strain and large-strain dynamic properties.
2. To investigate the importance of softening models in lateral pile modeling.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Literature review
2. Synthesize and process the existing data. The field work and all data collection was performed in July/Aug 2002.
3. Analyze the results from the vibrational data to determine dynamic stiffness and damping factors versus deflection level
4. Compare measured stiffness and damping ratios with computed values and results from large-strain (statnamic) tests.
5. Submit report to UDOT with recommendations for design of pile groups.
6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

This work would be performed in one year. July 05-June 06.

5. Indicate type of research and / or development project this is:

Large: ☒ **Research Project** ☐ **Development Project**
Small: ☐ **Research Evaluation** ☐ **Experimental Feature** ☐ **New Product Evaluation** ☐ **Tech Transfer Initiative :** ☐
Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University with oversight from UDOT staff on technical advisory committee.

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7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Report containing recommendations for design. The report will also contain an implementation summary will concisely describe modifications to design methods which are developed from the field testing

8. Describe how will this project be implemented at UDOT.

The geotechnical and structural groups will use these recommendations for the design of pile foundations during earthquakes. Recommendations could also be provided to UDOT consultants.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT design engineers will use this information to evaluate dynamic stiffness and damping.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Because the field measurements have already been made, the obstacles are minor and the analysis should be relatively straightforward.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Jon Bischoff

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $30,000-35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Jon Bischoff	Structural Geotechnical Section/UDOT/Complex	965-4326	Yes
B)Darin Sjoblom	Structural Geotechnical Section/UDOT/Complex	964-4474	Yes
C) Marv Halling	Civil & Environmental Engineering/USU	435 797-3179	Yes
D) Kyle Rollins	Civil & Environmental Engineering/BYU	422-6334	Yes
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA, NSF, Caltrans**,**

RESEARCH PROBLEM STATEMENT

Problem Title: Improved Performance of MSE Walls **No.: 05.07-5**

Submitted By: Travis M. Gerber, BYU **E-mail:** tgerber@byu.edu

1. Briefly describe the problem to be addressed:

Several MSE wall installations on UDOT projects have not performed as intended. In the case of Silver Creek Junction and the I-15 Reconstruction Project, adverse performance was associated with inadequate compaction of the MSE wall backfill material. MSE wall manufacturers recognize that compaction near the wall face is problematic and typically specify a zone of nominal compaction behind the wall which is typically at least a meter wide. Use of "self-compacting" fill in this zone would be desirable, but specifications are lacking. Also, the presence of this zone contributes to differential stiffness and settlement within the MSE wall backfill. These effects are poorly quantified and pose issues relative to assessing bearing/global stability, particularly for walls perched on sloping embankments.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop recommendations for MSE wall backfill material which compacts with minimal effort, while considering shear strength and drainage issues.
2. Develop recommendations for assessing stability of MSE walls which account for the differential stiffness of backfill behind the wall face.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Review technical literature
2. Conduct analytical study of void ratio and relative density variability as function of grain size distribution and other characteristics
3. Correlate backfill characteristics with compactibility criteria.
4. Conduct analytical study of wall performance using FLAC models [parametrics include wall height, width of MSE zone, embankment slope, width of nominal compaction zone, reinforcement type, stiffness of nominally compacted backfill]
5. Correlate models with static equilibrium design procedures
6. Prepare final recommendations and report

Total estimated person hours: ~1,000 (student and faculty)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Ideally, this work would be accomplished under a 6-month schedule [as required by a designation as a small research evaluation project]. While scheduling is somewhat flexible, one possible work period might be Jan 06 – June 06, which takes advantage of student availability for research during spring/summer months.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative
☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University researcher with consultant experience, together with supervision and oversight by UDOT staff as part of technical advisory committee.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Report containing recommendations for design procedures and specifications.

8. Describe how will this project be implemented at UDOT.
Structures Geotechnical Section and Structures Design Section will use recommendations for the design and review of MSE wall installations. Recommendations can be incorporated in specifications and design guidance documents (e.g., manual of instruction).

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
UDOT will benefit from improved performance and reliability of MSE walls. Also, delays and reconstruction costs which have occurred when existing MSE walls have performed adversely will be avoided.

10. Describe the expected risks, obstacles, and strategies to overcome these.
Backfill specifications cannot be too restrictive and must allow reasonably suitable materials to be used. Multiple propitiatory MSE wall systems exist and consideration must be given to various manufacturer requirements.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Darin Sjoblom

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $19,880

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Jon Bischoff	UDOT – Structures Gotechnical Section		
B)	Jim Higbee	UDOT – Structures Gotechnical Section		
C)	Michael Fazio	UDOT – Structures Hydraulics Section		
D)				
E)				
F)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: FHWA

RESEARCH PROBLEM STATEMENT

Problem Title: Legacy Highway Strong Ground Motion Array No.:

Submitted By: Steven Bartlett E-mail: bartlett@civil.utah.edu

1. Briefly describe the problem to be addressed: Strong ground motion can cause significant damage to transportation facilities. This research proposes to design and install a strong ground motion array at a major interchange for the purpose of: 1) earthquake assessment, 2) emergency response, 3) engineering evaluations

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Optimize accelerometer locations (free field, downhole, structural)
2. Develop standard details and specifications that can be used for other projects
3.

3. List the major tasks required to accomplish the research objective(s):

		Estimated ~~person-hours~~ student hrs.
1.	Review other DoTs installations and standard details	80
2.	Optimize downhole locations	80
3.	Optimize structural locations	160
4.	Optimize downhole locations	80
5.	Develop std. drawings & specs.	160
6.	Report	160
		720 hrs. @ $12/hr = $8640.00

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Proposed schedule is 1 yr. using graduate student labor

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1) standard drawings
2) specifications
3) technical report

8. Describe how will this project be implemented at UDOT.

(see above)

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

1) Improved emergency response
2) Improved seismic safety
3) Optimize seismic design

10. Describe the expected risks, obstacles, and strategies to overcome these.

If installation is done by contractor, then this will have to be coordinated

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Jim Higbee

12. Estimate the cost of this research study including implementation effort (use person-hours from No 3): ($8640 faculty + $6000) x 1.1 = $16 K ←

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Jim Higbee	UDOT/Legacy Parkway	951-1026 ext 318	yes
B)	Steven Bartlett	U of U	(801)587-7726	yes
C)	Walter Arabaz	U of U seismostation	(801) 581-7410	no
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Mitigation Design for Lateral Spread at Bridges No.:

Submitted By: Steven Bartlett E-mail: bartlett@civil.utah.edu

1. Briefly describe the problem to be addressed: Lateral spread can cause severe damage to bridges & bridge approaches during earthquakes. A calibrated numerical model is needed to design the ground improvement and remediation strategy for bridge sites on liquefiable soils.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Improve prediction of lateral spread at bridge approaches
2. Develop numerical model design tool for mitigation evaluations
3. Implement model using select remedial case histories

3. List the major tasks required to accomplish the research objective(s):

		Estimated person-hours
1.	Compilation of modeling case histories	160
2.	Calibration of numerical model	320
3.	Verification of model w/ remediated sites	320
4.	Development of implementation examples	160
5.	Report writing and review	160
6.	Training	80
		1200 hrs. @ $15/hr. = $18,000

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The proposed schedule is one year duration using a graduate student.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Design method, guidance document, technical report, training seminar

8. Describe how will this project be implemented at UDOT.

Design guidance available to design-build contractors

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Improved seismic safety of bridges,
Lower liquefaction remediation costs

10. Describe the expected risks, obstacles, and strategies to overcome these.

None

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Jim Higbee

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3) ($18K faculty + $12K) x 1.1 = $33K ←

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Jim Higbee	UDOT/Legacy Parkway	951-1026 ext. 318	yes
B)	Steven Bartlett	U of U	(801)587-7726	yes
C)	Farhang Ostadan	Bechtel	(415) 768-3734	no
D)	Faiz Makdisi	Geomatrix	(501) 663-4100	no
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

National Center for Earthquake Engineering Research (NCEER)
CalTrans
Pacific Earthquake Engineering Research (PEER)
NSF

RESEARCH PROBLEM STATEMENT

Problem Title: Local Correlations for Soil Classification and Shear Strength Parameters from CPT Results No.: 05.07-9

Submitted By: Evert Lawton
Steve Bartlett
E-mail: Lawton@civil.utah.edu
Bartlett@civil.utah.edu

1. Briefly describe the problem to be addressed:

There have been many research studies conducted locally within the past decade for which soil classification and high quality shear strength tests have been conducted on specimens obtained from boreholes adjacent to locations where Cone Penetration Tests have been performed. However, there have been no systematic studies done to determine if statistically meaningful correlations can be developed between the CPT results and these soil parameters, or if existing correlations done for soils from a variety of locations or soils from other regions can be applied to the local soils. Therefore, this vast database of results has not been used to its fullest extent.

2. List the research objective(s) to be accomplished:

a. Determine if sufficient data exists to establish statistically significant correlations between CPT parameters and soil classification (Soil Behavior Type) for local soils. If not, provide recommendations for additional work needed to establish the correlations.

b. Determine if sufficient data exists to establish statistically significant correlations between CPT parameters and shear strength parameters (undrained shear strength for cohesive soils and friction angle for granular soils)for local soils. If not, provide recommendations for additional work needed to establish the correlations.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

a. Find and assimilate existing data for local soils with respect to soil classification, strength parameters, and CPT parameters where CPT tests were conducted adjacent to the boreholes from which the test specimens were obtained. Results from CU triaxial tests on high-quality specimens will be used as the "ground truth" or "baseline" data for the undrained shear strength of cohesive soils, and results from CD triaxial tests and borehole shear tests will be used as ground truth data for the friction angle of granular soils. (150)

b. Analyze the data to determine if any existing correlations are statistically meaningful and can be used as-is to provide reliable predictions for local soils. (120)

c. Develop statistically meaningful correlations for soil classification and strength parameters from existing data. (250)

d. If statistically meaningful correlations cannot be developed from existing data (task c), develop details of additional field and laboratory tests that need to be done to establish statistically meaningful correlations. (200)

e. Write report (100)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

One year study.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐
Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Classification chart applicable to local soils. Empirical correlation for friction angle of local granular soils (likely as a function of cone tip resistance and effective overburden pressure). Empirical relationship for undrained shear strength of local cohesive soils (likely as a function of cone tip resistance and total overburden pressure).

8. Describe how this project will be implemented at UDOT.

If CPT results are available, anyone can use the correlations to estimate the soil classification and shear strength of the soil based on the CPT results.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from the results of this project by having statistically meaningful correlations to use to predict the soil classification and shear strength of local soils. Within UDOT, the beneficiaries will primarily be the Geotechnical Division and consultants performing work for UDOT. The results will also be beneficial to anyone performing geotechnical investigations and design within the local area.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Grant Gummow

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Evert Lawton	University of Utah, Civil & Environmental Engineering	585-3947	
B)	Steve Bartlett	University of Utah, Civil & Environmental Engineering	587-7726	
C)	Steve Saye	Kleinfelder (Omaha Office)	(402) 331-2260	
D)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Drained Strength, Stress-Strain and Bulk Modulus Parameters for the Bonneville Clay **No.:** 05.07-10

Submitted By: IGES Inc. - Ryan Thomas Cole, Ph.D., P.E. **E-mail:** ryanc@igesinc.com

1. Briefly describe the problem to be addressed:

The goals of this study is to obtain drained strength parameters for the Bonneville Clays. The parameters will be obtained by performing drained triaxial tests on Bonneville soil samples obtained using a piston sampler. Currently there is data available characterizing the undrained behavior of the Bonneville Clays using SHANSEP procedures. This data was used extensively during the I-15 expansion. However, experience has shown that the SHANSEP procedure may be more of a lower bound approach for modeling the strength of the Bonneville Clays resulting in a more conservative, time consuming approach to staged construction of embankments and therefore more costly. Reliable drained strength parameters are needed to further quantify if the behavior of the Bonnneville Clays more closely behave undrained (as in the SHANSEP method), drained, or somewhere in-between (partially drained)when subjected to construction loads. A Drained strength database for the Bonneville Clays is needed as an upperbound approach for staged construction and to further characterize its behavior. These data could be used for effective stress design of embankments with rates of construction controlled based on monitoring of porepressures. Additionally, such a data base would provide useful information for characterizing the modulus and stress field necessary for more realistic finite element and finite difference modeling of the Bonneville Clays.

2. List the research objective(s) to be accomplished:

1. Obtain a suite of Shelby samples of the Bonneville using piston samplers near areas with extensive consolidation and undrained parameters (such as the South Temple site)
2. Perform drained (CD)triaxial tests on undisturbed portions of the Shelby tube samples. X-ray methods would be used to evaluate sample disturbance and select sections of the samples to be tested.
3. Using the data, derive the strength, stress-strain, Young's modulus, and bulk modulus parameters using an elastic approach (Duncan et al., 1980) and/or a plastic approach (Hardening-soil model)

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours** 350

1. Review of sites along in the valley with extensive consolidation and undrained soil parameters. Identify at least one, preferably two sites for Bonneville Clay samples

2. Field exploration to obtain high quality samples, would include rotary wash and piston sampling. Potential for UDOT Staff to participate by using their drill rig and equipment

3. X-Ray Shelby tube samples to identify relatively undisturbed sections for testing

4. Laboratory testing – consolidated drained (CD) triaxial tests (depending on the number of sites selected this may include 30-40 tests).

5. Data reduction and preparation of report for UDOT

4. Outline the proposed schedule (when do you need this done, and how we will get there):

1. Literature review and background research – 1 month
2. Field exploration and sample collection– 1-2 months based on availability of UDOT drilling equipment
3. Laboratory testing – 5 to 7 months
4. Data reduction – 2 month

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant with significant experience in performing tests partnership with UDOT Staff, corroboration with University for site selection and data reduction.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Report containing drained strength database and methodologies for obtaining and reducing the data.

8. Describe how will this project be implemented at UDOT.

The findings of this study can be incorporated into UDOT's specifications including recommendations for alternate approach to highway embankment design and staged construction incorporating requirements for foundation porepressure monitoring.. Revised approach will have direct applicability on embankment designs for Legacy Highway and future upgrades proposed for other segments of I-15 as well as other areas of the State where soft foundation conditions exist.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This information will provide information for drained analysis of constructed embankments which can be used in conjunction with the SHANSEP parameter previously derived to provide an upper and lower bound for embankment stability and construction. The information will also be beneficial in providing stress-strain and modulus parameters for finite element and finite difference models ranging from consolidation to slope stability.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Obtaining quality samples – rotary drilling and piston sampling will be used to obtain high quality samples. Additionally, each Shelby tube will be x-rayed to ensure the appropriate sections are tested. Fully automated, servo controlled, and data acquisition equipment will be used to obtain reliable data and significantly reduce labor costs associated with such testing (IGES currently has these capabilities).

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Jon Bischoff

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

Scope of work is anticipated to be $20,000 (for a minimum of 32 tests) assuming UDOT will provide the drill rig equipment and labor necessary for obtaining the samples.

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A)			
B)			
C)			
D)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Local universities

RESEARCH PROBLEM STATEMENT

Problem Title: Performance of pile to pile cap connections under lateral loads

No.: 05.07.11

Submitted By: IGES Inc. - Ryan Thomas Cole, Ph.D., P.E.

E-mail: ryanc@igesinc.com

1. Briefly describe the problem to be addressed:

The goal of this study is to investigate the lateral resistance afforded to a pile cap through pile to pile cap connections covering a range of embedment depths into the cap. The study would include full-scale testing of connections covering the ranges typically used by UDOT. Pile to pile cap connections have a significant influence on a pile cap behavior during lateral loading. Typically, piles are embedded or connected to a pile cap and a fixed connection is assumed. However, a fixed connection is seldom achieved as rotation of the pile within the pile cap occurs due to stress concentrations and stiffness differences between the steel and concrete. Pile cap connections generally fall somewhere between a fixed and free (pinned) condition the degree to which they more closely resemble is either dependant on pile embedment depth and composite pile stiffness. A Pile caps resistance to lateral loads increases as the degree of fixity of the connection increases, as such significant savings can be realized for pile caps where lateral loads govern the design by incorporating this parameter into the design.

2. List the research objective(s) to be accomplished:

1. Investigate the performance of a range of pile to pile cap connections under lateral (transverse)loading.
2. Investigate the influence the pile to pile cap connection has on its lateral resistance and the potential savings through incorporating the rotational restraint into design. Research will be limited to pipe and H-pile sections commonly used in the Salt Lake Valley.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours** 1500-1800

1. Literature review and background research.
2. Construction of pile to pile cap connections -
3. Construct / prepare testing facility
4. Perform full-scale testing of the constructed connections
5. Data reduction and preparation of report for UDOT

4. Outline the proposed schedule (when do you need this done, and how we will get there):

1. Literature review and background research – 1 month
2. Construction of pile to pile cap connections for up to 6 pile sections– 2 months
3. Construct / prepare testing facility – 2 months
4. Perform full-scale testing of constructed connections – 1 month
5. Data reduction and preparation of report for UDOT – 3 months

5. Indicate type of research and / or development project this is:

Large: X Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant and University partnership corroborating with UDOT Staff throughout the study to provide useful and applicable results.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Report with recommendation for incorporating the pile to pile cap connection in design; resulting in more economical designs when lateral loads govern the design of pile caps. Report would include recommendations for depth of embedment, rotational restraint values, and pile to pile cap connections details.

8. Describe how will this project be implemented at UDOT.

The findings of this study can be incorporated into UDOT's specifications including recommendations for incorporating the pile to pile cap connection in design. The results from this study can also be implemented into detail drawings for construction of the pile to pile cap connection. The results can be used as a screening tool to identify previously constructed pile caps which may be under designed relative to available lateral capacity. Revised approach will have direct applicability on design of pile foundations for Legacy Highway and future upgrades proposed for other segments of I-15.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

A realistic representation of the pile to pile cap connection incorporated into design and potential significant cost savings where increased lateral capacity can be projected.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Developing appropriate test setup to optimize data obtained and applicability of test setup to closely model typical connections used throughout Utah. We plan to work with local universities to develop a testing program applicable to future design, construction, and retrofits.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Jon Bischoff

Estimate the cost of this research study including implementation effort (use person-hours from No. 3): Scope of work is anticipated to range from $75,000 - $95,000 depending on the total number of connections tested and final scope of study. The number of connections tested would depend on the literature review, typical ranges used throughout Salt Lake City, and recommendations from UDOT Staff.

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Travis Gerber	Brigham Young University	801.422.1349	Yes
B)			
C)			
D)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Other State DOT's

RESEARCH PROBLEM STATEMENT

Problem Title: Development of MSE wall inspection plan based upon failure mode analysis and risk assessment No.: 05.07-12

Submitted By: James A. Bay and Loren R. Anderson, Utah State University E-mail: jim.bay@usu.edu

1. Briefly describe the problem to be addressed:

U-DOT has a large and growing inventory of MSE walls. These walls are a critical part of the State's transportation infrastructure. Nearly all of the critical structure of an MSE wall is buried, where it is difficult to assess its condition. Additionally, MSE walls are complicated systems where failures in several different components can lead to failure in the walls. U-DOT has variety of different types of MSE walls, which have different vulnerabilities. In order to identify and correct any problems that might arise with these walls, U-DOT needs a systematic inspection and monitoring program. We propose to develop such a program. This program will be developed based upon a probabilistic risk assessment analysis that accounts for the probabilities and consequences of failure. A panel of experts from U-DOT, the MSE wall industry, FHWA, and academia, will be assembled to determine the possible failure modes, the probabilities of failure, and the consequences of failure. The actual inspection and monitoring will be performed by U-DOT personnel.

2. List the research objective(s) to be accomplished:

1. Develop a catalogue of U-DOT MSE walls.
2. Compile a history of MSE wall failures.
3. Assemble an expert panel to a) determine failure modes, b) assign probabilities to each failure mode, and c) evaluate the consequences of each failure mode.
4. Perform probabilistic risk assessment to identify the failure modes that contribute a significant risk for each type of wall in the U-DOT inventory.
5. Develop an inspection and monitoring program to mitigate the risk due to the critical failure modes.

3. List the major tasks required to accomplish the research objective(s):	**Estimated person-hours**
1. Develop a catalogue of U-DOT MSE walls	120 hrs
2. Compile history of MSE wall failures	60 hrs
3. Assemble expert panel and provide them with catalogue and historical data	40 hrs
4. Limited field investigation to evaluate current condition of steel reinforcement	100 hrs
5. Prepare for expert panel meeting	20 hrs
6. Conduct two day expert panel meeting	48 hrs
7. Prepare report on panels findings	20 hrs
8. Perform risk assessment analysis to identify the most critical failure modes	80 hrs
9. Develop inspection and monitoring plan to mitigate risk	100 hrs
10; Train U-DOT personnel to implement the inspection and monitoring plan	60 hrs
11. Submit final report to U-DOT	30 hrs

4. Outline the proposed schedule (when do you need this done, and how we will get there):

May-Aug 2005 Prepare for panel meetings (Tasks 1-5)
Sep 2005 Conduct panel meeting (Tasks 6-7)
Oct-Nov 2005 Perform risk assessment (Task 8)
Dec 2005- Jan 2006 Develop inspection and monitoring plan (Task 9)
Feb 2006 Conduct training for U-DOT personnel (Task 10)
Apr 2006 Submit final report to U-DOT

5. Indicate type of research and / or development project this is:

Large: ☐ **Research Project** ☒ **Development Project**
Small: ☐ **Research Evaluation** ☐ **Experimental Feature** ☐ **New Product Evaluation** ☐ **Tech Transfer Initiative :**
☐ **Other** _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1) Catalogue of U-DOT MSE walls, 2) History of MSE wall failures, 3) Report on expert panel findings, 4) Detailed MSE wall inspection and monitoring plan, 5) Training sessions for U-DOT personnel, and 6) Final report.

8. Describe how will this project be implemented at UDOT.

This project will provide a detailed inspection and monitoring plan for U-DOT MSE walls. Engineers and maintenance personnel will be trained to perform inspection and monitoring and in assessing the condition of the walls. This inspection and maintenance plan will then be implemented by U-DOT employees.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

U-DOT will benefit by having tools to asses the condition of the MSE walls in their inventory. Problems with the wall should then be identified early enough to allow for corrective actions prior to catastrophic failures.

10. Describe the expected risks, obstacles, and strategies to overcome these.

There are no particular risks in this work.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Mike Garcia, Construction and Maintenance

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Jon Bischoff, Geotech			
B)	Jim Higbee, Legacy			
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA

RESEARCH PROBLEM STATEMENT

Problem Title: RECOMMENDED METHODS AND UNIT COSTS FOR ROCKFALL HAZARD MITIGATION No.: 05.07-13

Submitted By: Fulvio Tonon E-mail: tonon@chpc.utah.edu

1. Briefly describe the problem to be addressed:

With many miles of roadway passsing through steep rocky terrain, the Utah Department of Transportation faces the major challenge of providing a safe highway system to the public. Rockfall potential is inherent in these areas, and the Agency is faced with the difficult task of reducing and managing the risk of rockfall. A systematic inventory of rock slopes is now available; it was prepared by following the Rockfall Hazrd Rating System (RHRS). Areas where rockfall would most likely affect the roadway are identified and rated. Rock slopes were divided into three categories: A, B, and C. A and B slopes need a rockfall remediation to be implemented. The number of highly hazardous slopes is staggering: 507 category A slopes were identified. These slopes also had detailed parameters gathered for them to help prioritize them. However, this detailed rating did not include the types of treatments that would be appropriate and the potential cost estimate for mitigation of each slope. Identifying these slope treatments and potential cost estimates would further help the UDOT benefit from the RHRS allowing them to better make informed decisions on where and how to spend construction funds with the aim of reducing risk associated with rockfall.

2. List the research objective(s) to be accomplished:

1. To enable UDOT to prepare preliminary design and cost estimates for category A slopes.
2.
3.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. To coordinate with the RHRS work done so far, and acquire the available rockfall database; 2
2. To perform a survey of the state-of-the-art remediation measures for rockfall and determine whether they are available and/or feasible in Utah; 400
3. To perform a survey of unit costs for the remediation measures determined at point b); 400
4. To perform a survey of other DOTs' approaches to rockfall hazard remediation, including ways to get State funds for the implementation of rockfall hazard mitigation; 200

4. Outline the proposed schedule (when do you need this done, and how we will get there):

First six months: Task 1) will be carried out through UDOT interaction. Tasks 2) through 4) will be carried out in one year through literature and market research, and contacts with and site visits to manufacturers, specialty contractors, and DOTs.

5. Indicate type of research and / or development project this is:

Large: Research Project ☐ Development Project
Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1) Report on a survey of the state-of-the-art remediation measures for rockfall and on other DOTs' approaches to rockfall remediation.
2) Recommendations on use of rockfall remediation measures by UDOT and on possible ways to obtain/increase (State) funds for implementing these measures.
2) Report on a survey of unit costs for the remediation measures determined at Point 1) and recommended at Point 2.

8. Describe how will this project be implemented at UDOT.

The project results will be implemented by UDOT to make informed decisions how to best spend rockfall remediation funds. The data it is to be used by Project Managers to scope up coming projects and it is used by Maintenance to fix the most critical areas when funding is available. The deliverable would be an asset for Design, Project Management and for Maintenance.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

In order to ensure legal protection, a system must be in place, by which needed rockfall remediation projects can be identified and implemented as funding is made available. Past experience has shown that, if such a system is in place, litigations brought against the State because of rockfall are either settled out of court or result in findings favorable to the State.
The results of this study will allow the UDOT to proceed with the project identification and implementation. The results will allow the UDOT to make informed decisions on where and how to spend construction funds in order to reduce the risk associated with rockfall. The findings will finally help UDOT determine strategies for obtaining funds for implementing these measures.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Now that the rock-fall inventory has been completed and the database is available, there are no obstacles to the implementation of this research.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Leslie Heppler, UDOT Geotech Division, 801-968-4318

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $19,800 (1 graduate student)

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Clifton Farnsworth	Region 3	227-8027	
B)			
C)			
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Cities, Counties, private industry

Utah Geological Survey

RESEARCH PROBLEM STATEMENT

Problem Title: Install New Instrumentation on the Legacy Highway New Bridges

No.: 05.08-2
(also 05.07-3)

Submitted By: Marv Halling, USU

E-mail:halling@cc.usu.edu

1. Briefly describe the problem to be addressed:

As new bridges are being constructed, the need for faster construction, more economical designs, and longer lasting infrastructure is becoming more and more important. These issues are paramount at the national level with FHWA Initiatives such as the "Bridge of the Future" and "Smart Structures." In order to improve the performance of modern structures, instrumentation and monitoring of representative structures is necessary. This problem statement addresses the need to install and maintain strong motion (earthquake) instrumentation as well as additional instrumentation.

2. List the research objective(s) to be accomplished:

1. To plan, design, and install long term monitoring instrumentation in representative structures during construction.

2. To place sensors in bridge and foundation systems that will be useful in detecting degradation of the structural component.

3. To establish procedures where bridges are selected and designated for various types of instrumentation.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Study the recommendations of FHWA, and take a survey of the approaches of other state DOTs.

2. Establish criteria for the selection of instrumentation and bridges to be instrumented.

3. Design of the instrumentation packages for one or two selected bridges on Legacy Highway.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

This project is anticipated to have a duration of approximately 1 year. The duration of one year is noted to allow for the flexible Legacy Highway schedule.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: X Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
The deliverable would be a set a guidelines regarding instrumentation of UDOT structures as well as instrumentation designs for one to two bridges on the Legacy corridor.

8. Describe how will this project be implemented at UDOT.
It is anticipated that the ignition project will be funded by the research division, with guidelines for long term future funding coming from construction funds for new construction and from repair funds.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.
The beneficiaries at UDOT will be the engineers charged with observation and maintenance of UDOT bridges.

10. Describe the expected risks, obstacles, and strategies to overcome these.
The main obstacle will be funding the longer term program. With interest in improved performance requirements for new construction, the monitoring of bridges will become a necessary construction cost. These expenses will be extremely small compared to construction budgets.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Jim Higbee/Boyd Wheeler

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $ 20,000.

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A	Todd Jensen, UDOT			
B)	Jon Bischoff, UDOT			
C)	Boyd Wheeler, UDOT			
D)	Paul Barr, USU			
E)	Keri Ryan, USU			
F)	Steve Bartlett, UU			
G)	Jim Bay, USU			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:
UU Seismic Stations, USGS, UGS, ANSS Program, FHWA

RESEARCH PROBLEM STATEMENT

Problem Title: Improvement of Abutments & Pile Caps Design **No.:05.08-3 (also 05.07-3)**

Submitted By: Kyle Rollins and Travis Gerber, BYU Civil Engineering **E-mail:rollinsk@byu.edu**

1. Briefly describe the problem to be addressed:

Various design recommendations are given for the passive force-deflection relationships for abutments and pile caps. Research suggests that resistance is substantially greater and that current recommendations are leading to costly increases in the number of piles to handle lateral load. Current UDOT specs. call for only 3 ft of compacted backfill around bent pile caps, but it is unknown how this will reduce the passive resistance relative to complete backfill. Various pile cap connections are presently used but very little guidance is available to define how these connections affect ultimate resistance and load-deflection relationships. Finally, most design recommendations ignore increased resistance due to damping which could also lead to greater economy. Full-scale dynamic tests can provide answers to these design issues and lead to significant cost savings. Testing equipment and personnel will be mobilized to Utah from California during summers 2005 and 2006 for a related study funded by NSF and can greatly reduce the cost of testing.

Strategic Goal: ☐ **Preservation** ☒ **Operation** ☐ **Capacity** ☒ **Safety** (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop passive force-deflection relationships for dynamic loads

2. Determine effect of pile cap connection details on abutment stiffness.

3. Evaluate damping coefficients for pile caps and backfills.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

1. Construct pile caps for testing which have different width/height ratios and connection details (varying from “pinned” to “fixed”).
2. Perform static and dynamic lateral load test on pile caps without backfill. (Static tests with 1300 kip actuators and dynamic tests with 100 kip eccentric mass shakers)
3. Evaluate stiffness-rotation relationship for pile caps with different connection details.
4. Perform static and dynamic lateral load tests on pile caps with compacted backfill extending three distances from the face.
5. Conduct analysis of test results to define static and dynamic passive force-displacement relationships and damping ratios for partial and complete compacted backfill cases.
6. Evaluate existing methods and recommend improvements to account for measured response.
7. Prepare final report with implementation summary.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Large eccentric mass shakers and personnel from UCLA will be in Utah in late summer 2005 and summer 2006 and can be used for these tests without mob/demob costs or major personnel time charges. The success of the project will hinge on coordinating with the availability of this equipment. Coordination will also be necessary to obtain supplemental funding from other DOTs. Ideally, the work would begin in May 2005. All field testing would be completed by mid-summer 2006. Analysis of test data would likely require six to eight months and a report would be completed at the end of the second year.

5. Indicate type of research and / or development project this is:

Large: ☒ **Research Project** ☐ **Development Project**
Small: ☐ **Research Evaluation** ☐ **Experimental Feature** ☐ **New Product Evaluation** ☐ **Tech Transfer Initiative :**
☐ **Other**_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University with supervision and oversight by UDOT staff as part of technical advisory committee.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.) A report will be prepared describing the results of the field testing and the analysis of the test data. The report will also contain an implementation summary which will concisely describe the design methods developed from the field testing and provide an example of its use for a typical problem. Results from the study will also be presented to the AASHTO bridge design technical committee on foundations for adoption in future AASHTO codes.

8. Describe how this project be implemented at UDOT.

The equations developed would be used in the design of new bridges and retrofit of old bridges by the structural and geotechnical engineers. Presentations on the use of the method will need to be provided by the researchers and a report will be available to UDOT consultants.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

By accurately accounting for dynamic passive resistance, pile foundations can be more efficiently designed which will reduce the number of piles, the size of pile caps, and the overall cost of bridge structures. In addition, the resulting structures will have increased safety against earthquake damage.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The costs associated with this project are relatively high but other state DOT's have expressed willingness to participate in a pooled fund project, thereby leveraging the cost to UDOT. Final commitment will require recruitment by UDOT and university personnel. The testing cost can be minimized if performed in summer 2005 and summer 2006 when 200 k capacity eccentric mass shakers from UCLA will already be mobilized to Salt Lake for related field testing.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Jon Bischoff/Hugh Boyle.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): $75k UDOT; $125k others

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Jon Bischoff	Structural Geotechnical Section/UDOT/Complex	965-4326	Yes
B) Hugh Boyle	Structural Design Group/UDOT/Complex	965-4517	Yes
C) Darin Sjoblom	Structural Geotechnical Section/UDOT/Complex	964-4474	Yes
D) Kyle Rollins	Civil & Environ. Engineering/BYU	422-6334	Yes
E) Travis Gerber	Civil & Environ. Engineering/BYU	422-1439	Yes
F) Marv Halling	Civil & Environ. Engineering/USU	435 797-3179	Yes
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Caltrans, NYDOT, Illinois DOT, Oregon DOT.

RESEARCH PROBLEM STATEMENT

Problem Title: Selection of Optimal Design Methods for Curved Girder Bridges No.:05.08-4

Submitted By: Keri Ryan, Utah State University E-mail: kryan@cc.usu.edu

1. Briefly describe the problem to be addressed:

Although UDOT engineers currently use the V-load method for curved steel girder design, a recent I-15 testbed report (Womack and Crookston, 2003) concluded that all curved girder bridges should be analyzed using some type of finite element analysis. This conclusion has been questioned since it is based on analysis of only one bridge, and the application of the V-load method (used to estimate observed strains from a load test) appeared to be inconsistent with traditional design applications. Therefore, a supplemental study is proposed to determine the optimal design method for curved girder bridges, which may vary depending on the bridge parameters.

Strategic Goal: ☐ Preservation ☐ Operation ☒ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Determine the optimal design method for curved girder bridges as a function of structural characteristics most likely to influence the behavior (e.g., curvature, span length, number of spans, girder spacing, number of girders, skew of supports).
2. Understand the cost implications (design cost versus construction cost) between acceptable methods of design.
3. In addition to the V-load method and finite element analysis, explore and evaluate any special software that may allow a more rigorous solution with less effort.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Review literature for comparative studies of the V-load method and other analysis methods.
2. Identify and attain evaluation versions of specialized software products that may be suitable for this application. Some possibilities are MDX Software and DESCUS I. By working with UDOT engineers and the project Advisory Committee, select the best software for the full finite element analysis. GT STRUDL may be a good choice since it is owned by UDOT.
3. Identify the structural characteristics that most influence the design of the bridge (based on literature review, sensitivity study, etc).
4. Develop a set of bridge models based on the structural characteristics identified, to represent a wide range of bridge behavior. These models could be based on recent designs by UDOT engineers.
5. Carry out the design for each bridge model using the alternative methods considered. Evaluate all designs against finite element analysis, which is considered to be the most accurate. If approximate methods are conservative, as expected, evaluate the potential cost savings by using a more rigorous method.
6. Prepare report.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The above tasks imply a comprehensive look at the problem, which may involve a multi-year study. With the understanding that a scaled down version may be preferred, the following rough schedule is proposed (starting in May 2005):

-1 to 3 months for Tasks 1 and 2, followed by an interim review to approve the software selections

-3 months for Tasks 3 and 4, followed by an interim review to approve the bridge models

-6 to 18 months for Task 5

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other_____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
The main deliverable is a report that includes the results of the study and proposed design standards for curved steel girder bridges. Another possible deliverable is a template and/or guidelines for creating a curved girder bridge model using finite element analysis software.

8. Describe how will this project be implemented at UDOT.

This project will be implemented by an internal evaluation of the report, and integration of the proposed design standards into a policy manual, which governs how both UDOT engineers and consultants are required to approach the design of the curved girder bridges.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The benefit is that UDOT design criteria for curved girder bridges are updated, leading to application of the appropriate design methodology for different scenarios. A long term design and construction cost savings is possible.

10. Describe the expected risks, obstacles, and strategies to overcome these.
One risk is that the scope of this project is too large given the expected outcome and likely funding commitment. This obstacle can be overcome by using the results of previous research to tighten the scope as much as possible. Interim reviews and deadlines should be used to keep the project focused and on schedule.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Ray Cook

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): < $20,000 (based on 1 yr project)

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)				
B)				
C)				
D)				
E)				
F)				
G)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

APPENDIX A

WORKSHOP AGENDA, BREAKOUT GROUPS, INSTRUCTIONS, AND VOTING PROCEDURES

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-AGENDA-
UTRAC WORKSHOP 2005

Ft. Douglas Officers Club
University of Utah
Salt Lake City, Utah

Thursday, March 3, 2005

Registration & Continental Breakfast: West Lobby, Officer's Club Building
7:30 am - Noon ***Workshop Registration***

Introductory Plenary Session: South Conf Room, Officers Club Building
8:30 am - 9:30 am ***Welcome, Purpose of Workshop***
Keynote Message – Carlos Braceras
Public Involvement in our Projects – Teri Newell
Instructions for Workshop

Morning Break: Main Hallway, Officers Club Building
9:30 am – 9:45 am ***Workshop sponsored break***

First Breakout Session: Officers Club & Commander's House
9:45 am - 11:45 am ***Problem presentations, discussion, and first prioritization voting***
(See map for room assignments)

Workshop Sponsored Lunch: South Conf Room, Officers Club Building
11:45 am - 1:30 pm ***Lunch***
Presentation of Trailblazer Award
Presentations from TRB- Chris Glazier & Clifton Farnsworth
Summary of Progress from Breakouts

Second Breakout Session: Officers Club & Commander's House
1:30 pm - 3:00 pm ***Problem Statement Refining: Objectives, Benefits, Champions, Implementation***

Afternoon Break: Main Hallway, Officers Club Building
3:00 pm - 3:30 pm ***Workshop sponsored break, Networking on Problem Statements***

Third Breakout Session: Officers Club & Commander's House
3:30 pm - 4:30 pm ***Problem Statement refinement & discussion:***
Deliverables, Tasks, & Budget
Final Prioritization Vote

Summary Plenary Session: South Conf Room, Officers Club Building
4:30 pm – 5:00 pm ***Submittal of Prioritized Project List***
Award of Door Prizes
Completion of Workshop Feedback and Evaluation

Adjourn Workshop: 5:00 pm

2005 UTRAC Workshop

BREAKOUT GROUPS

GROUP 1: Construction

Group Leader: Darrell Giannonatti
Research Contact: Robert Stewart

GROUP 2: Maintenance

Group Leader: Richard Clarke
Research Contact: Barry Sharp

GROUP 3: Materials & Pavements

Group Leader: Tim Biel
Research Contact: Doug Anderson

GROUP 4: Hydraulics, Environmental, & Roadway Design

Group Leader: Brent Jensen
Research Contact: Michelle Page

GROUP 5: Planning & Asset Management

Group Leader: Kim Schvaneveldt
Research Contact: Abdul Wakil

GROUP 6: ITS, Traffic & Safety

Group Leader: Richard Manser
Research Contact: Ken Berg

GROUP 7: Geotechnical

Group Leader: Jon Bischoff
Research Contact: Blaine Leonard

GROUP 8: Structural

Group Leader: Todd Jensen
Research Contact: Daniel Hsiao

2005 UTRAC WORKSHOP – BREAKOUT SESSION INSTRUCTIONS

There will be eight groups.
Check the map to determine where each group will meet.
Group leader to provide laptop and projector, if being used.
Contact Blaine Leonard, Elaine Chatfield, or Doug Anderson for additional A/V or facilities needs.

Group leaders have copies of all Problem Statements, from all groups, in their binder.
Participants have only the Statements from this group.
Everyone has summary sheets that show the Problem Statement names from every group.

Session 1: Morning

Introduce all the members of the group. Don't assume that everyone knows each other.

Take some time for each Problem Statement.
- Have the submitter describe the nature of the work.
- The Research Contact may have some additional information to share.
- Discuss how each project will this be useful to UDOT, how it will fit our priorities?

Vote to select highest priority problem statements
- Use paper ballots found in Tab 12 of Group Leader binder
  - There are only 12 ballots. Distribute them as described on the "voting instructions"
- Research Contact will tally votes, using paper form or spreadsheet on floppy disk
- Group leader to determine how many projects to select in the morning voting
  - Vote tallies may have a natural break point to help determine how many to keep

Session 2: Early Afternoon

- Refine problem statements and evaluate in more detail
  - Use the Problem Statement Review Checklist in Tab 2 to help evaluate
  - Make sure there is a person (not a division) who will champion each project
  - Evaluate implementation
    - Who is going to do this, when, and how?
  - Are the objectives and tasks listed on the Statement appropriate and complete?

- Determine if there are other Problem Statements in other groups that you are interested in.
  - Assign someone to follow up with those groups during or after the break.

Session 3: Late Afternoon

- Evaluate detailed scope, budgets. Can it be done for this budget?
- Are the deliverables useful and appropriate?
  - Who will use them and how? Refine your expectations of the deliverable.

- Final prioritization vote
  - Use the paper ballots, as before
  - Vote only for those projects which are still under consideration
    - Specific ranking from morning vote is not relevant in this vote

- Report prioritization results to Blaine Leonard at conclusion of session

2005 UTRAC WORKSHOP – VOTING PROCEDURES

Voting will be by secret paper ballot.

There will be two votes – one at the end of the morning breakout session, and another at the end of the last afternoon breakout session. Ballots will be marked by participants, then tallied using the spreadsheet contained on the floppy disk in the front pocket of the binder.

Ballots are contained in the Group Leader's binder, under tab 12.

- There are 12 ballots for the morning vote.
- There is a "ballot tally sheet - morning" in case you don't have a laptop.
- There are 12 ballots for the afternoon vote.
- There is a "ballot tally sheet - afternoon" for manual use.
- The ballots are separated by a colored sheet.

For each vote, there are only 12 ballots. The ballots should be used as follows:

- Six ballots for UDOT participants.
- Three ballots for University participants (one per university).
- Two ballots for consultants, contractors, or outside agencies.
- One ballot for FHWA.

If there are more people than ballots, the group will share the ballots. For instance, if there are 15 UDOT people in the group, they would get together in groups of two or three to share a ballot. The total votes shall always be twelve or less.

<u>Morning Breakout Session Prioritization Vote</u>

Use the first 12 ballots. Participants, individually, or in small groups of 2 or 3, will mark the ballots for their top five projects. They should place a "1" in the box next to their first choice problem statement, a "2" next to their second choice problem, etc. Participants give the ballots to the Research Contact in the group, who will tally them.

Each "first place" vote will give 10 points to that problem statement,
Each "second place" vote will give 8 points to that problem statement,
Each "third place vote will give 6 points to that problem statement, etc.

The spreadsheet on the disk, under the "ballot tally sheet – am" tab, will be used to tally the ballots and summarize the total scores. If a laptop isn't available, this tally can be done manually, or the ballots can be brought to Blaine Leonard, who can tally them on the main computer.

The problem statements with the highest scores will become the priority projects for the first voting session.

<u>Afternoon Breakout Session Prioritization Vote</u>

Use the first 12 ballots. Once again, participants will mark their top five problems. Some of the problem statements shown on the ballot will have been eliminated during the first round, so participants will need to be careful to only mark problems that are still eligible.

The ballot tally will be done in the same manner as the first tally, using the sheet on the disk, under the "ballot tally sheet – pm" tab, or manually.

Bring the results of the voting to Blaine Leonard at the final joint session, using the tally sheet.

APPENDIX B

WORKSHOP ATTENDEES

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UTRAC 2005 ATTENDEES

Mr. Stan Adams
UDOT CONSTUCTION
Group 4

Mr. Hiram Alba
IGES
Group 7

Mr. Douglas Anderson
UDOT RESEARCH
Group 3

Mr. Lars Anderson
UDOT REGION 2
Group 4

Mr. Francis Ashland
UTAH GEOLOGIC SURVEY
Group 7

Dr. Paul Barr
UTAH STATE UNIVERSITY
Group 8

Dr. Steve Bartlett
UNIVERSITY OF UTAH
Group 7

Mr. Doug Bassett
UDOT REGION 3
Group 6

Dr. Jim Bay
UTAH STATE UNIVERSITY
Group 7

Mr. Austin Baysinger
UDOT SYSTEMS PLANNING
Group 3

Mr. Jared Beard
Group 2

Mr. Ken Berg
UDOT RESEARCH
Group 6

Mr. Jeff Berna
FHWA
Group 4

Mr. Lynn Bernhard
UDOT MAINTENANCE
Group 2

Mr. Tim Biel
UDOT MATERIALS
Group 3

Mr. Jon Bischoff
UDOT GEOTECHNICAL
Group 7

Mr. David Blake
UDOT REGION 2 -
MATERIALS
Group 3

Mr. Doyt Bolling
UTAH T2 CENTER
Group 3

Mr. Bruce Bonebrake
UTAH DWR
Group 4

Mr. Tim Boschert
UDOT SYSTEMS PLANNING
Group 4

Mr. Hugh Boyle
MICHAEL BAKER
Group 8

Mr. Keith Brown
UDOT GEOTECHNICAL
Group 7

Mr. Stan Burns
UDOT ENGINEERING
SERVICES
Group 6

Mr. Lee Cabell
HORROCKS ENGINEERS

Mr. Steve Call
FHWA
Group 5

Mr. Jerry Chaney
UDOT ENVIRONMENTAL
Group 4

Mr. Brian Christensen
HORROCKS ENGINEERS

Mr. Mack Christensen
UDOT REGION 2
Group 6

Mr. Dan Church
PARSONS BRINCKERHOFF
Group 8

Mr. Richard Clarke
UDOT MAINTENANCE
Group 2

Mr. Rob Clayton
UDOT TRAFFIC & SAFETY
Group 6

Mr. Brandon Cloward
UDOT REGION 2

Mr. Ryan Cole
IGES
Group 7

Mr. Tracy Conti
UDOT OPERATIONS
Group Float

Mr. Ray Cook
UDOT STRUCTURES
Group 8

Mr. Jim Cox
UDOT REGION 3
Group 3

Mr. Jason Davis
UDOT REGION 2
Group 2

Mr. Fred Doehring
UDOT PPMS
Group 4

Mr. Darin Duersch
UDOT REGION 1
Group 6

Mr. J. R. Duncan
ASH GROVE CEMENT
Group 3

Mr. Paul Egbert
UDOT
Group 4

Mr. David Eixenberger
UDOT STRUCTURES
Group 8

Mr. Mike Ellis
UDOT STRUCTURES
Group 8

Mr. Todd Emery
FHWA
Group 3

Mr. Clifton Farnsworth
UDOT REGION 3
Group 7

Mr. Michael Fazio
UDOT HYDRAULICS
Group 4

Mr. Sean Fernandez
UDOT
Group 6

Mr. Larry Gay
UDOT REGION 4
Group 3

Dr. Travis Gerber
BRIGHAM YOUNG UNIV
Group 7

Mr. Darrell Giannonatti
UDOT CONSTRUCTION & MATERIALS
Group 1

Mr. Chris Glazier
UDOT ISS
Group 5

Dr. William Grenney
UTAH STATE UNIVERSITY
Group 4

Dr. Spencer Guthrie
BRIGHAM YOUNG UNIV
Group 3

Mr. Todd Hadden
UDOT

Dr. Dee Hadfield
UTAH STATE UNIVERSITY
Group 2

Dr. Marv Halling
UTAH STATE UNIVERSITY
Group 8

Mr. Corbett Hansen
KLEINFELDER
Group 7

Dr. Don Hayes
UNIVERSITY OF UTAH
Group 4

Ms. Leslie Heppler
UDOT GEOTECH
Group 7

Mr. Jim Higbee
UDOT GEOTECHNICAL
Group 7

Mr. Daniel Hsiao
UDOT RESEARCH
Group 8

Mr. Ahmad Jaber
UDOT SYSTEMS PLANNING

Mr. Brent Jensen
UDOT ENVIRONMENTAL
Group 4

Ms. Rae Ann Jensen
UDOT RESEARCH

Mr. Todd Jensen
UDOT LEGACY HIGHWAY PROJECT
Group 8

Mr. Neldon Jones
Group 6

Mr. Cameron Kergaye
UDOT PROJ DEVELOPMENT
Group 5

Mr. Dave Kinncom
UDOT TOC - ITS
Group 6

Mr. Gary Kuhl
UDOT SYSTEMS PLANNING
Group 3

Mr. Bill Lawrence
UDOT SYSTEMS PLANNING
Group 6

Dr. Evert Lawton
UNIVERSITY OF UTAH
Group 7

Mr. Bryan Lee
UDOT

Mr. Nathan Lee
UDOT REGION 1
Group 3

Mr. Blaine Leonard
UDOT RESEARCH
Group 7

Ms. Shana Lindsey
UDOT RESEARCH
Group 2

Dr. Henry Liu
UTAH STATE UNIVERSITY
Group 6

Mr. Vincent Liu
UDOT
Group 6

Dr. Peter Martin
UNIVERSITY OF UTAH
Group 6

Mr. Mike Marz
UDOT
Group 5

Mr. Jack Mason
UDOT REGION 2
Group 2

Mr. Raeleen Maxfield
UDOT CONSULTANT SERVICES

Mr. Deryl Mayhew
UDOT TOC
Group 6

Ms. Mitzi Mcintyre
UTAH CHAPTER ACPA
Group 3

Mr. Jim Mcminimee
UDOT PROJ DEVELOPMENT

Mr. Robert Miles
UDOT REGION 2

Mr. Richard Miller
UDOT PROJ DEVELOPMENT
Group 4

Dr. Woodruff Miller
BRIGHAM YOUNG UNIV
Group 4

Mr. Paul Mooney
FHWA
Group 7

Mr. Scott Munson
UDOT REGION 4
Group 2

Mr. Dave Nazare
UDOT REGION 3
Group 8

Mr. Lloyd Neeley
UDOT SYSTEMS PLANNING
Group 2

Dr. Jim Nelson
BRIGHAM YOUNG UNIV

Ms. Teri Newell
UDOT REGION 2

Mr. Kevin Nichol
UDOT SYSTEMS PLANNING
Group 5

Ms. Karen Nichols
STANTEC CONSULTING
Group 4

Mr. Steve Ogden
UDOT PRICE DISTRICT
Group 2

Ms. Esther Olsen
UDOT RESEARCH

Ms. Michelle Page
UDOT REGION 2
Group 4

Mr. Marco Palacios
UDOT REGION 3
Group 4

Mr. Randy Park
UDOT REGION 2

Dr. Sanja Perica
UNIVERSITY OF UTAH
Group 4

Mr. Garyn Perrett
IWORQ
Group 5

Dr. Joe Perrin
UNIVERSITY OF UTAH
Group 6

Mr. Troy Peterson
UDOT
Group 3

Mr. Brian Phillips
UDOT REGION 3
Group 2

Mr. Jason Phillips
HW LOCHNER

Mr. Brad Price
RB&G ENGINEERING
Group 7

Mr. Greg Punske
FHWA
Group 4

Ms. Betty Purdie
UDOT REGION 2
Group 2

Mr. Mohammad Rahman
GRANITE
Group 3

Mr. George Ramjoue
WASATCH FRONT REGIONAL COUNCIL
Group 5

Mr. Eric Rasband
UDOT
Group 5

Dr. Kyle Rollins
BRIGHAM YOUNG UNIV
Group 7

Dr. Pedro Romero
UNIVERSITY OF UTAH
Group 3

Mr. Tim Rose
UDOT REGION 2
Group 4

Dr. Keri Ryan
UTAH STATE UNIV
Group 8

Ms. Helen Sadik-Macdonald
UDOT ENVIRONMENTAL

Dr. Mitsuru Saito
BRIGHAM YOUNG UNIV
Group 6

Dr. Grant Schultz
BRIGHAM YOUNG UNIV
Group 5

Mr. Brent Schvaneveldt
UDOT REGION 3
Group 4

Mr. Kim Schvaneveldt
UDOT PLANNING
Group 5

Mr. Barry Sharp
UDOT RESEARCH
Group 2

Mr. Darin Sjoblom
UDOT GEOTECH
Group 7

Mr. Reed Soper
UDOT ENVIRONMENTAL
Group 4

Mr. Roland Stanger
FHWA
Group 6

Mr. Robert Stewart
UDOT REGION 2
Group 1

Dr. David Strayer
UNIVERSITY OF UTAH
Group 1

Mr. Denis Stuhff
UDOT STRUCTURES
Group 4

Mr. Jeff Tanabe

Mr. Ritchie Taylor
UDOT REGION 2

Mr. Rodney Terry
UDOT REGION 1
Group 3

Mr. Stuart Thompson
UTAH LTAP
Group 6

Ms. Kristina Tingey
UDOT
Group 4

Dr. Fulvio Tonon
UNIVERSITY OF UTAH
Group 7

Mr. Troy Torgersen
UDOT REGION 4
Group 6

Mr. Rick Torgerson
UDOT REGION 4
Group 6

Mr. Bill Townsend
UDOT REGION 2
Group 5

Mr. Tom Twedt
BIO-WEST
Group 4

Mr. Bruce Vandre
UDOT SYSTEMS PLANNING
Group 3

Mr. Kevin Vanfrank
UDOT MATERIALS
Group 3

Mr. Paul Vidmar
UDOT
Group 5

Mr. Abdul Wakil
UDOT RESEARCH
Group 5

Mr. Bob Westover
UDOT REGION 3
Group 1

Mr. Boyd Wheeler
UDOT STRUCTURES
Group 8

Mr. Robert Wight
UDOT REGION 2
Group 1

Mr. Grant Wiley
UDOT REGION 3

Dr. Les Youd
BRIGHAM YOUNG UNIV
Group 7

Dr. Alan Zundel
BRIGHAM YOUNG UNIV

APPENDIX C

WORKSHOP EVALUATION RESULTS

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2005 UTRAC – TRANSPORTATION RESEARCH WORKSHOP

March 3, 2005 – Fort Douglas, University of Utah, Salt Lake City

Workshop Evaluation

31 Reponses

		Strongly Agree	Agree	Disagree	Strongly Disagree
1)	The Workshop was well organized?	7	24	0	0
2)	The general sessions were productive?	5	21	4	0
3)	The breakout group session was well organized?	7	20	3	0
4)	The breakout group facilitator was effective?	7	20	3	0
5)	Having problem statements submitted in advance was an effective approach?	23	8	0	0
6)	We had a good set of problem statements to start with?	16	13	2	0
7)	The breakout problem statement refining process was efficient and effective?	1	23	6	1
8)	The voting process was fair and effective?	6	16	7	1
9)	The meeting facilities were satisfactory?	8	15	7	0
10)	The breaks were timely and goodies met my needs?	13	16	1	0
11)	The lunch arrangements and provisions were satisfactory?	12	16	2	0
12)	The general location of the workshop was satisfactory?	8	20	2	0
13)	Overall, the workshop was worth the time spent?	9	20	1	0

		Too Long	Just Right	Too Short
11)	Would you rate the duration of the workshop…?	4	26	0

Additional Comments:

Late Submissions were allowed. I feel this circumvents the process. The varying size of groups and conglomeration clutters the process.

Access (distance and traffic on 4th and 5th South) and parking at the UofU campus is too difficult. Also, the campus map was a little erroneous, and could have been made more clear.

Let only projects with UDOT Champions be presented.

1) My statement was lost, and I had to go back to my office and retrieve it. 2) Make it a 4-hour thing, max. 3) Tell what the budget is. It is useless to spend a day refining something that will never be funded. 4) We were told to prepare small 20k projects, but it looked like decisions were made before hand to pass an 80k BYU project when the estimated budget is 50k per group.

Blaine did a great job with UTRAC this year. Thanks for all the effort you put into UTRAC, Blaine. Brent and Michelle did a wonderful job keeping our group on track. Overall EXCELLENT use of time and money. I do have a few comments. I would like to have the information packet, with the studies, prior to UTRAC. It would give me more time to process the problem statements. I also think it would be beneficial to have two computers in each session to reduce set up time between presentations. For example, while one presentation is being given, the next can be setting up. Some of the speakers could have used preparation notes or information on "how to make a successful presentation". It would benefit their cause. I was glad to see Research open to schedule changes and not keep everyone there if work was completed. Thanks for asking for my input.

1) General session audio was poor, 2) Group 5 leader unprepared, 3) voting process "homemade", i.e. made up by leader, 4) Group 5 room too narrow, 5) Need better representation of statements, 6) Should eliminate statements from packet that will not be voted upon, 7) Should allow group to innovate new statements during session, 8) This form should allow for more evaluations of group leader.

Felt the voting process was weighted too heavily to the Complex: 4 votes for Regions and 2 votes for Complex, when the Regions deal with the problems. Happy that Central Materials was willing to contribute funds.

Bring statement forms from previous years to discuss if they are still relevant.

Further organization of the schedule, expectations, requirements, are needed, although this year's workshop was better than in years past (more productive). Consider weighting each group's products according to the number of problem statements submitted to that group, i.e. construction had 3 statements, while traffic & safety had 19.

Great work & preparation, UofU is the central location for all.

Not clear when project is in what category. Although a lot of papers were presented, they were good topics and warrant discussion. Need to assign an IT person to assist with A/V issues.

1) Need to require advance submission of visuals and have prepared together for workshop. Way too much time spent setting up each time, very inefficient. 2) Hydraulics / Design / Environmental Group too big, should split hydraulics off as they have too many attendees and projects.

Need to keep presenters on schedule and not too verbose. Good workshop. Thank you.

Need to have follow-up from previous year's submissions included in the breakouts.

Consider further evaluation of statements first and only vote once in the afternoon.

Very good, need to get imaginative for long term future.

The breakout groups need to be organized a little better. The environmental group had 13 proposals, while others had only 3 or 4! This didn't seem fair to environmental ideas, particularly when you consider many of the issues could have easily been placed in design or structures. A lot of the hydrology issues seemed more to design than environmental.

Should look at adding a group to the list. Project management I feel has needs that could be and should be addressed with research projects.

Great workshop, well organized, good venue.

Consider separating environmental from hydraulics and design.

All groups should refine statements prior to the workshop.

Officer's Club too small & crowded. Parking not adequate.

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APPENDIX D

PROJECT PRESENTATIONS

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Teri Anne Newell, Project Manager, Mountain View Corridor Public Input

I'm probably going to be your most non-technical presentation today so I'll keep it brief and try to see what I can apply to research out of our public involvement effort. Mountain View Corridor, if you don't know anything about it, is a project that is all about growth on the west side of Salt Lake Valley and Northern Utah County. Our study area, as you can see on the map over there, is about five miles wide and forty miles long, so we have a whole lot of stake holders in that area. We had to be pretty careful about how we used our limited funds to reach out to those people. We wanted to make sure that we targeted really well for the type of information that we wanted to get; and I think that's one key point for you. If you want to get information back from the public, you really have to know who you want to get that input from.

We spent a lot of time thinking about our audience and what type of input we wanted to get on the project, and we made that transition through the process. This graphic shows the different phases of our project. We use different tools to outreach to the public and this shaded line has a peak at about two-thirds of the way across on the map. That represents the real peak in our public involvement. We had about one thousand comments during that phase of the process because we purposefully targeted certain groups.

At the very beginning of the process, we worked with a group called Envision Utah and took a new approach on this project. We learned some things from them. Their method of outreaching to the public is to key into people that the community respects and knows. They had mayors send out letters to property owners, and anyone they thought would be interested in working in a planning process and invited them to some meetings where we sat around tables with maps. It was a real key to use mayors who were influential to get their citizens to come to the meetings as opposed to sending a letter from UDOT, which people have a tendency to ignore and don't want to participate. If it came from their mayor, it meant a lot more to them.

In the next step we developed alternatives in our project and got to a point where we decided the most important thing to us at that stage was to let the people who are near the proposed alignments, understand that there might be a freeway near their home. We didn't want them to find out when we got to the draft document in the public hearing. We wanted them to know the name of the project. We wanted them to know where they could call to get information or a website to go to. We used numerous tools at that stage once we had alternatives developed. We used some radio because we found a group we hadn't gotten much response from was a middle-aged group of people with young families who didn't have the time to come talk to us, and didn't have the time to really find out about our project. So we used some radio that targeted that age group and got the name of the project out there and drove them to our website. We had huge number of hits on our website during that time. Those weren't the type of people who wanted incredibly detailed information but we wanted to make sure they knew about the project.

Another method we used was our 'talk truck'. A lot of people have heard about the talk truck on this project and are very interested in it. It was a new idea. I think you guys are supposed to be here to be innovative today. We allowed our team to be creative and come up with some new ideas for public outreach. It was a little bit risky at the beginning of the project. Basically we had

a billboard on a truck, and we parked it at pre-arranged locations during the day. We handed out fliers to whole neighborhoods to try to get them to come to a meeting. We held fifteen different meetings across our study area. Our most successful ones were held in Magna, where we parked in a Reams parking lot with the truck and had three project representatives who were able to give five to ten minute presentations on the project and then stand around with a group of fifteen to twenty people and answer questions. Another thing I want to point out about that process, is that it was incredibly effective because it was their meeting. It was not our meeting. It was in their neighborhood, at their grocery store. We had very few project representatives there and we handled two hundred and fifty people in one night; answering questions. It was effective because we were on the ground with them. We weren't trying to present to a huge group. It was a small group setting. And it really was their meeting. And it could be a bit intimidating at times when you had twenty angry people standing around you, but they really felt they were getting the right answers; because you weren't in a room where the project team vastly out-numbered the number of people coming to talk about the project. It's hard to describe the feeling at those meetings. They just were very effective. The whole team felt, as we talked about it afterwards, that these were very effective meetings. People are talking about this tool and trying to use it everywhere, but what I want to do is caution you to use it carefully. It's a good tool for when you want to go out to people, get in their neighborhoods, and get them to come talk to you. But you can't use this when you need to get detailed information from them or give them detailed information. We were at a phase of our project where we said, "we've got some lines on a map that are conceptual, we can talk to you about general issues, we can try to answer your detailed question," but we didn't have detailed maps at that point. I think that's a key to remember because people have said to us, "oh, you're going to continue to use the talk truck. You'll use that and somehow you are going to turn your public hearing into a talk truck?" No, it doesn't really apply at that point. A key thing with public involvement is to make sure you target your audience. Find out what type of information you want to get from them and then really target how you get that information.

There was a lot of legwork that went into the talk truck. We went to city council meetings before that. We have twelve cities in this study area, two counties, and several townships. I don't know how many presentations we gave. We have a speakers group that goes around and gives presentations to whoever wants to hear from us. So we did a lot of legwork ahead of the talk truck meetings. Again, we were on the ground with the people, talking directly to them and it was a lot of hard work, and it was stressful work, but it was very effective.

Earlier in the process, Envision Utah had put out a survey. They got very little response to the survey. When we went out and did the talk truck, we got nearly a fifty percent return of comment forms from the public that attended those meetings. So we found it was hugely effective when we went out and talked with them and answered their questions. They were willing to give us something on paper because we had invested our time with them. So that's a key thing to rememberm, too. If you want good feed back from people, talk directly to them. That's where you're going to get that real hard-core good information.

So, in summary, keep in mind, know who your audience is and target directly to them. If the type of information you want to get back from people is important enough, I would encourage you to hire someone who knows how to get to those groups effectively. As engineers and technical people, we don't always have the best skills to know how to get information out of people and if

it’s important enough to you to get that information, talk with the people who really know what they are doing. I have been lucky enough on my project to have a great team to work with. That is my message today.

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Chris Glazier, GIS Specialist: Powerpoint Presentation for "Vehicle Detection and Classification Using Model-Based and Fuzzy Logic Approaches"

TRB PAPER January 2005

Vehicle Detection and Classification Using Model-Based and Fuzzy Logic Approaches

Hengda Cheng
H. N. Du
L. M. Hu
Chris A. Glazier c o-author/presentation

Initial Issues

- Current automatic vehicle classification systems have deficiencies: low accuracy, special requirements, fixed orientation of the camera, or additional hardware/devices
- Vehicle detection and classification system using the model-based and fuzzy logic approaches. The system was tested using a variety of images captured by the highway traffic control center of the UDOT

Major advantages of the proposed system are:

1. High classification accuracy
2. No special orientation of the camera is required
3. No additional devices are needed

Current Modeling Issues

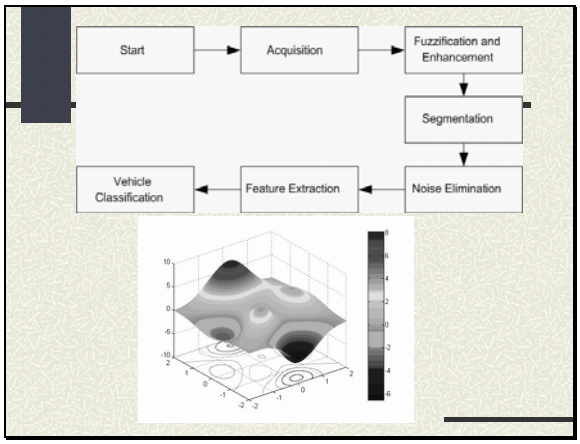
- Simple models tend to be less accurate and cope poorly with some problems, such as multiple overlapping vehicles
- More complicated models tend to give more accurate estimation but require more computational resources.

The proposed system

- To Extract Vehicle Features this model uses a 2D projection of a 3D vehicle and estimates the width, length and height of the vehicle
- The wheels of the vehicles are also detected and used to further refine Classification into FHWA Categories

Preprocessing Steps

- Fuzzification of the Images
- Contrast Adjustment
- Noise Filtering
- Image Enhancement



Processing the Image

- Segment the Vehicle from Background (subtraction)
- Apply Threshold Operation Convert Grayscale Image to Binary Image
- Perform Edge Detection and pattern recognition in the fuzzy domain.

Fuzzy Note

Many image processing applications use fuzzy logic, and fuzzy set theory has become useful for dealing with ambiguity and uncertainty in images.

In this system, we have employed fuzzy logic to transform ordinary images into the fuzzy domain, and then the fuzzified images are enhanced.

Details of the S_function, histogram, fuzziness, and maximum entropy are include in the paper

Step1 Lane Detection

- After the lanes have been detected and the orientation and position of the lanes have been calculated, vehicles can be located much faster and more accurately. Vehicle shadow elimination and wheel detection can also be solved more easily
- How? Look for the white marks

sample

Step 2 Find the Vehicle

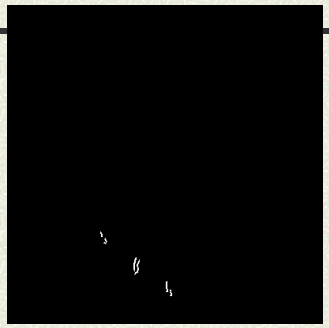
- Vehicle Image by subtraction of background
- Edge detection analysis
- Is it a Truck? Yes/No
- Pass image of “Large” vehicles to Axle Feature Extraction

sample

No. of Axles and Classification

- Using previous technologies, trucks with more than 4 axles cannot be correctly classified because they are similar in geometric sizes. Wheel (axle) detection is specifically useful for classifying the trucks with different axle configurations such as classes 8, 9, and 10, or classes 11, 12 and 13
- The Prewitt operator is used to detect the edge of the wheels by mapping lower gray scale levels than the surrounding areas
- The no. of axles and the spacing are then used to complete the vehicle classification

sample



The Classifcation Tree

- Based on the tree searching algorithm

1. Use length and height to classify cars, trucks and mid-size vehicles
2. Use the ratio of length to height to classify mid-size vehicles such as pickup trucks and vans
3. Pre-defined axle count and distances are used to classify trucks with more than 3 axles, or multi-trailer vehicles

Performance Evaluation

- Pentium IV average processing time = 9.388 seconds for 265 images = 35ms per image. The speed meets the requirement of real time processing
- Even though the images suffered from poor quality, and even some images were even corrupted by a bright strip, this approach, was able to classify the images well
- overall accuracy was 98.87%.

Other Methodologies

Algorithm	Class	Accuracy	Requirement
Local-feature based (7)	4	54%	Overhead view
Model-based classification (8)	2	92.3%	N/A
Deformable templates (18)	5	91.9%	Side View
Split-merge segmentation (9)	4	85%	Side view
Monocular image sequence (11)	2	70%	N/A
Machine learning (19)	3	75%, 92%, 93% respectively	N/A
Vision based (20)	5	94%	N/A
Laser sensor based (21)	5	89%	Laser sensor units

Novel Method

	Total classified	Correctly classified	Accuracy
Class 1	2	1	50%
Class 2	115	115	100%
Class 3	109	107	98.2%
Class 4	0	0	N/A
Class 5	12	12	100%
Class 6	8	8	100%
Class 7	6	6	100%
Class 8	2	2	100%
Class 9	6	6	100%
Class 10	1	1	100%
Class 11	0	0	N/A
Class 12	2	2	100%
Class 13	2	2	100%
Overall	265	262	98.87%

Motorcycles

- Motorcycles were not successfully classified due to 1) the size of the vehicle, and 2) the resolution of the camera

Conclusion

- This system not only can classify the vehicles into more categories, but also has achieved a remarkable level of accuracy
- **This methodology does not require special orientation of the camera**. This enables cameras installed and used by the highway traffic control center of UDOT to be used for the intended purpose of Traffic monitoring and Incident Management, but these same cameras can act as vehicle classification data collection devices at the same time
- The system can detect and classify vehicles in **real time**

Contacts

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Clifton Farnsworth, Geotechnical Field Engineer: Powerpoint Presentation for "Long-Term Instrumentation Program to Monitor Various Geo-Technologies Used on the I-15 Reconstruction Project"

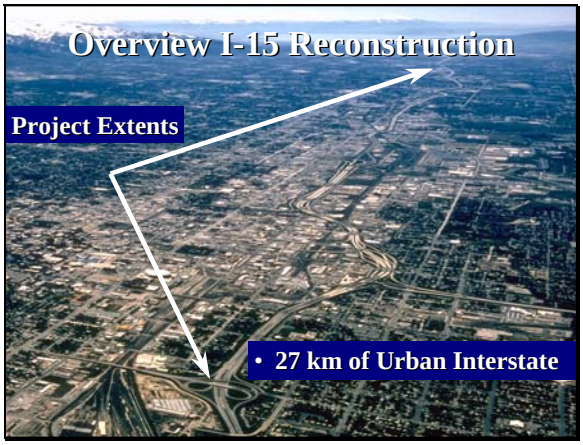
Long-Term Instrumentation Program to Monitor Various Geo-Technologies Used on the I-15 Reconstruction Project, Salt Lake City, Utah

Clifton Farnsworth and Steve Bartlett

UDOT

THE UNIVERSITY OF UTAH

Overview I-15 Reconstruction



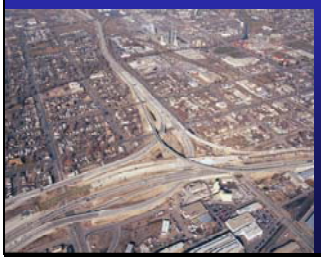
Overview I-15 Reconstruction

5 Lanes in Each Direction
Plus Auxiliary Lane

144 Structures

Overview I-15 Reconstruction

3 New Freeway to Freeway Connections



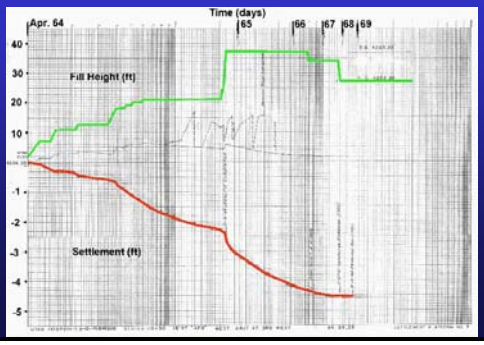
8 New Interchanges

Overview I-15 Reconstruction

- Design-Build Project
- $1.5 Billion
- Constructed in 4-Years (2 phases)

Geotechnical Conditions

Settlement Record

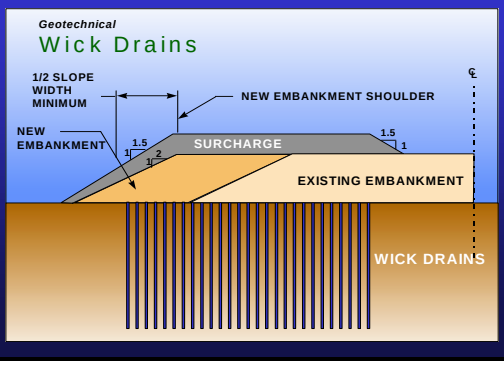


Geotechnical Conditions

Issues Regarding Lake Bonneville Sediments

- Large Amount of Primary Settlement
- Relatively Long Duration of Primary Settlement
- Rate and Amount of Secondary Settlement

Typical Embankment Construction



Various Geo-Technologies

Prefabricated Vertical Drains

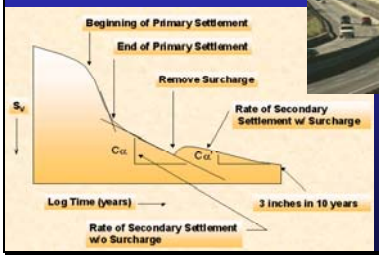
PV Drain Spacing
1.5 to 2.5 m
triangular spacing

Time to 90% Primary Consolidation = 90 to 180 days

Various Geo-Technologies

Preloading to Reduce Settlement

Surcharge heights are 30 to 40 percent of embankment height



Various Geo-Technologies

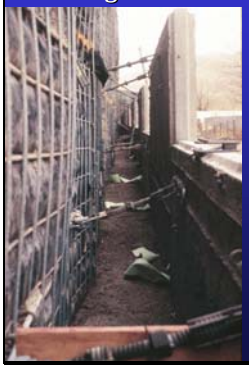
2-Stage Mechanically Stabilized Earth Walls

Right-of-way constraints required many slopes to be built vertically

Beginning of 2-stage MSE Wall

Various Geo-Technologies

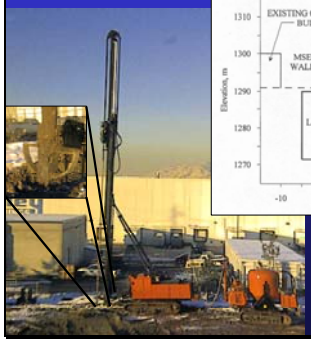
2-Stage Mechanically Stabilized Earth Walls

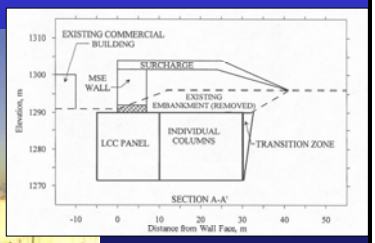


Concrete Fascia Panel

Attachment of Panels with Threaded Rod

Various Geo-Technologies
Lime Cement Columns





LCC Cross-Section

LCC Installation

Various Geo-Technologies
Geofoam

Geofoam Wall prior to tiltup panel wall placement

Geotechnical Data

- Baseline Geotechnical Data
- Contractors Construction Data
- UDOT Research Construction and Post-Construction Data

Purpose of Monitoring Project

- Gathering field data during construction and post-construction periods
- Compare the performance data against design performance goals and criteria
- Assess the adequacy of design methods
- Make recommendations regarding design methods

Instrumentation Considerations

How to go about setting up a long-term monitoring project?

Instrumentation Considerations
Project Scope

- What needs to be learned about this foundation treatment/embankment?
- What instrument types are available?
- Do the instruments provide needed level of accuracy and precision?
- Is there a location where this instrumentation can be accommodated?
- Will the layout meet project objectives?

Instrumentation Considerations
Project Budget

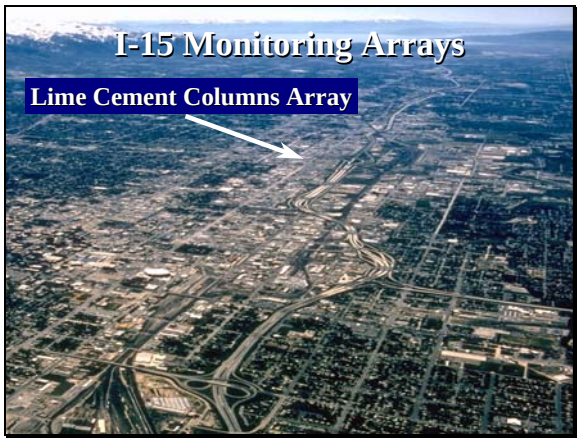
- How much funding is available?
- What type of instrumentation is affordable?
- Where will the funding best be spent to achieve project objectives?
- How much funding is necessary to maintain and read the instrumentation?
- Will certain types of instrumentation save the project money?

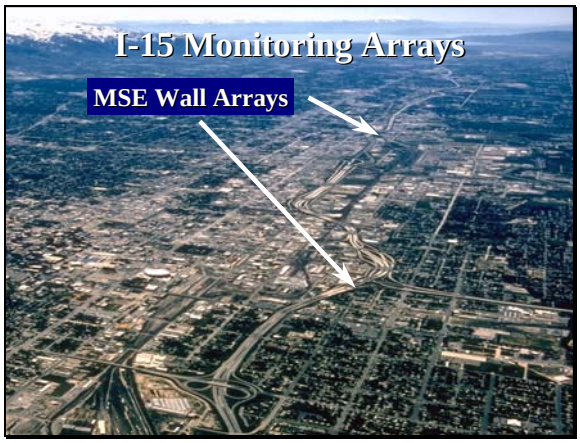
Instrumentation Considerations
Additional Considerations

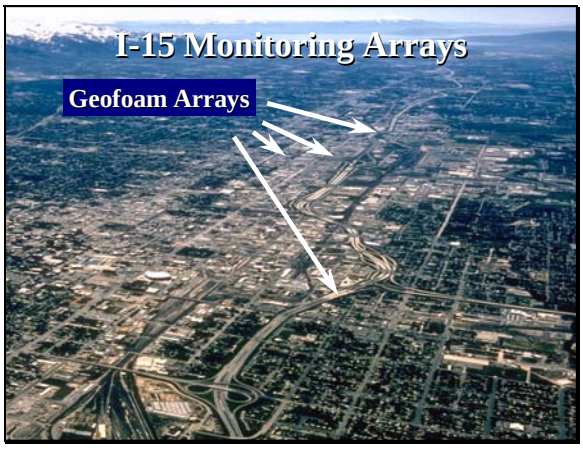
- How will the instrumentation be protected from construction related activities?
- Will the instrumentation be accessible once construction is complete?
- What precautions are necessary to ensure that the reader remains safe?
- How will the instrumentation be protected and maintained for long-term reading?

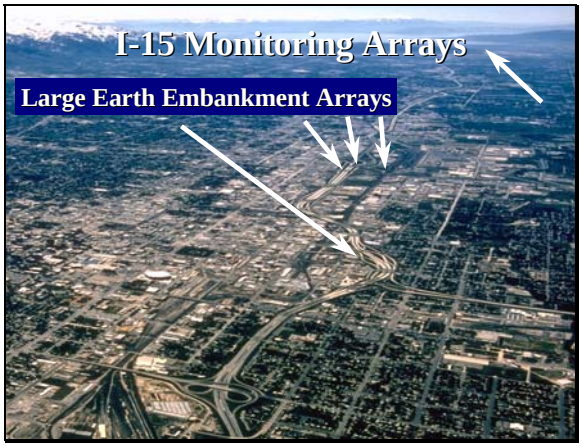
Instrumentation Considerations
Staffing Considerations

- Who is going to collect the data?
- Who is going to maintain the data?
- Who is going to interpret and report the data?









Array Name	Types of Instrumentation						
	Horizontal Inclinometers	Magnet-Reed Extensometers	Pressure Cells	Settlement Cells	Settlement Manometers	Settlement Points	Thermistors
LCC	X	X	X	X		X	
2nd S	X						
35th S	X					X	
1st S	X	X	X			X	X
SS-07			X				
SS-05	X	X				X	
33rd S		X	X			X	
4th S		X				X	
9th W		X				X	
Mainline		X				X	
Merger		X				X	
Provo	X		X		X	X	

Key Points Learned

1 - Identify the desired objectives

Example Objectives

1st South Geofoam Array

- Monitor construction and long-term settlements.
- Measure the vertical stress distribution through the geofoam layers.
- Measure the temperature profile within the pavement structure above the geofoam.

Key Points Learned

2 - Identify suitable location (appropriate embankment geometry balanced with safety)

3 - Coordinate with contractor

4 - "Accidents" happen – be prepared to fix things

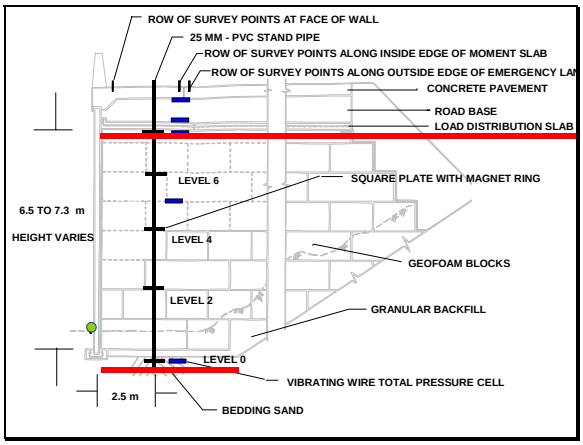
Broken Pipes

Cut Wires

Even things in "safe places" can be damaged

Key Points Learned

5 - Keep instruments in groups where possible



Instrumentation placed adjacent to each other can provide a better picture of what is happening…

Key Points Learned

6 - If possible provide some redundancies

Instrumentation is in traffic lane

Instrumentation is in planter-box

Key Points Learned

7 - Secure instrumentation for long term reading

Protect instrumentation for long-term reading

Before

After

Key Points Learned

8 - Maintain data and make backup copies

Reading Schedule

- At least weekly reading during active fill placement or construction
- Weekly reading during first 3 months
- Monthly reading during subsequent 9 months
- Quarterly reading during 2nd and 3rd years
- Semi-annual reading during subsequent years

Summary

- Assess the adequacy of the design methods used…
- Make recommendations regarding future application of these design methods…

www.udot.utah.gov/res/

cliftonfarnsworth@utah.gov
(listed on paper)

QUESTIONS???